American Fern Journal

A QUARTERLY DEVOTED TO FERNS

Published by the

AMERICAN FERN SOCIETY

EDITORS

C. V. MORTON

R. C. BENEDICT IRA L. WIGGINS

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In Memoriam

Charles Alfred Weatherby

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[Volume 39, No. 4, of the Journal, pp. 97–128, was issued December 17, 1949]

Charles Alfred Weatherby, 1875-1949

HENRY K. SVENSON

In earlier days of systematic botany the science was usually dependent upon a patron or presiding genius, and such a place I think Charles Alfred Weatherby occupied in the Fern Society. Indeed there was much unsought opportunity. Soon after the office of treasurer was thrust upon me in 1933 it was apparent that I was a treasurer without a treasury; furthermore, printer's bills extended beyond this vacuity to the extent of $500.00. A personal note by Mr. Weatherby paid the printer's bill. When $250.00 had been etched off by our payments, the remainder was given by Mr. Weatherby to the Society. An increase in membership and the sale of back numbers of the Fern Journal did gradually pull the Society out of the financial woods, but it was Mr. Weatherby who held the Society together through this and many other precarious times.

But this had not been my first association with him. Shortly after my return to college in 1919 I heard that C. A. Weatherby was to come as an assistant at the Gray Herbarium, in fact had already come on from Hartford. I had been interested in Charles Wright, the botanical explorer of Cuba, who likewise came from Hartford, and Mr. Weatherby told me that some of the plants collected by Wright around Hartford had only recently been rediscovered. Weatherby looked much the same then as in later life, rather thin, erect, always well-dressed, with a short-clipped mustache (which was to become whitened in later years), always polite, ready to help, and after the passing of Dr. Robinson always with a key to the garden gate and the herbarium in case one should wish to remain after hours or come in on Sundays. I under-

CHARLES ALFRED WEATHERBY, GRAY HERBARIUM, 1922 stand that a few close friends called him "Alfred," but he was nearly always called "Mr. Weatherby"; this I suspect was due to a certain dignity in his manner and behavior, but also to the high respect in which he was held by his associates.

As a boy he had grown up in East Hartford, Connecticut, where he was born on Christmas Day, 1875. Life in this village was simple and quite different from the rush of the present day—and it has been well told by Professor Fernald in the biographical sketch in the September, 1949, number of Rhodora. Since the town did not support a school which prepared for Harvard, Charles Weatherby went to a local school conducted by Mr. Bowman, and then to the Classical School at Hartford. He entered Harvard in the Class of 1897, graduating *summa cum laude*, his chief interest being in languages and literature; in addition to Phi Beta Kappa, he belonged to the Shakespeare Club, two other literary clubs, and Delta Upsilon. Daily themes, required for a course on English composition, he thought were a basis for good writing. Surely none of our contemporary botanists have been able to produce such beautifully written, subtly humorous, characterizations as those he wrote of the old Connecticut botanist Barratt.[1] At Harvard his chief interest was in languages, and he acquired there, in addition to modern languages, a good knowledge of Latin, which he applied in a non-pedantic style to whatever botanical material needed treatment. Never robust, the years of study extending into 1898 were too much, and he was an invalid for five years. From his boyhood friend, Charles Hanmer, I have received a letter which I can do no better than to quote:

"I had the pleasure of knowing Alfred Weatherby for about fifty years, as our families lived opposite on Main Street, East Hartford, Conn. He was away from town several years at Harvard. Upon his return to town he

[1] Rhodora **23**: 121–125; 171–177. 1921.

was ill for a long time and I can well remember his lying out on his veranda in the sun in a steamer chair. Eventually, after a long time he recovered, and as soon as he was able, started in collecting plants. At first, he used to drive a horse and later the Weatherbys had one of the first automobiles in town and he was thus able to cover all the State in his collecting. I do not think there was a road or by-way he did not know, and he was a fine driver; the Hanmers had many interesting collecting days together. He built up a beautiful herbarium which was a pleasure to see. Knowing nothing of botany, my earliest plants came from him around 1904, which started me out as a collector. He always went over my plants that I had collected that season. A collection of *Primula* (*P. officinalis* Jacq.) that I found up in Gray, Maine, pleased him. He also on several occasions came to visit us at Fisher's Island, where we collected many plants. On one trip there, I had collected a plant that when he saw it, he said, "Charlie, I don't know it and I shall have to take it up to the Gray Herbarium." He later advised me that it was *Agropyron cristatum*. He stated that this grass had not been collected east of the Rocky Mountains. I may add that his going leaves a void; I shall always remember him as a true friend, a kindly, fine gentleman."

In 1929 the Weatherbys set up their household at 27 Raymond Street in Cambridge. To reach the house from the Gray Herbarium one passed the enormous ginkgo in the Botanic Garden, the dilapidated rock garden where once the most interesting of greenhouses had stood, past a row of gigantic old beeches and through a small gate—one of the two which gave visitors access to the Garden. The Weatherby house was diagonally across the street. The location lent itself to the hospitality offered to Gray Herbarium visitors, and soon many of them had made a beaten trail. The large living room, occupying practically the entire front of the house, was well-furnished, and the Weatherbys were especially proud of their oriental rugs, many of them museum pieces, that hung from the gallery which occupied one end of the living room.

A large piano attested to his musical tastes, and he had also an interest in military history which he approached from the point of view of the moves of chessmen—a series of plans and byplays not too unlike the various interlockings of the phylogenetic systems of plants and the points set out by individual generals and little kings in their skirmishes in the field of plant taxonomy. In shaded beds in the yard and close up against the house foundations were planted many thriving species of native ferns together with interesting species of wild flowering plants. At the Gray Herbarium, students interested in ferns usually climbed with Mr. Weatherby to the front third-story room of the Gray Herbarium—above the entrance—where he did his research close to the cases which housed the fern collections, and where he was relatively free from the interruptions which his kindly nature allowed many visitors to impose upon him. There he carried out much of his work, achieving what was perhaps the best judgment on our fern problems of the eastern States. The climbing fern (*Lygodium*) grew in East Hartford—so abundantly at one time as to give the plant the name "Hartford Fern,"—and its presence undoubtedly stimulated him in fern study. Among other things, he conscientiously tracked down the types of variations treated by him in "A List of Varieties and Forms of the Ferns of Eastern North America."[2]

Mr. Weatherby's connection with the American Fern Society began long ago. By 1915 he was one of the editors and remained so until 1940. He was President in 1943 and 1944, and during the span of years did much to determine the policies of the organization. For Maxon he had great admiration and he felt that Maxon, more than anyone else he knew, had an instinctive understand-

[2] THIS JOURNAL, 1935–36.

ing of "species" of plants. He became greatly interested in the *Notholaena-Cheilanthes* complex of Central and South America. During his several trips to Europe he spent much of his time looking up "types," and examined with diligence the types of Desvaux's ferns at Paris.

But by no means did he confine himself to the ferns. His interest was much more general, and in the examination and photography of types throughout the collections in Europe he was helped by Mrs. Weatherby who, furthermore, is an accomplished artist. In London, in 1933, I ran across him quite by accident in the rooms of the Linnaean Society, where both of us were looking at the collections of Linnaeus, and the fragmentary but nevertheless interesting collections now preserved of Walter's herbarium from Carolina. And in 1937 he passed just ahead of me at Berlin and Paris, where he was highly thought of by the curators. For Diels' arrangement of ferns he had especial respect. When Mrs. Svenson and I returned to London, we had dinner in various places with the Weatherbys. Then we left for Ireland, while the Weatherbys got an automobile and covered a considerable bit of the countryside, being especially interested in the seacoast and moors of northern Cornwall. Ferns are particularly abundant in the wilder parts of Cornwall, especially the hart's tongue.

Wherever they went on vacation they found something of botanical interest. Thus in a summer in Nova Scotia he turned up the red-root (*Lachnanthes*), a coastal-plain plant hitherto not known north of Plymouth County in Massachusetts. And while on Grand Manan he collected sufficient material to write an account of the species of that island, one of the larger ones off the Maine coast. The New England states provided constant short notes of observations, and during an automobile trip from Texas to New York he was able to obtain a fine series of plants from the state of Tennessee, from which little had been known since the early collections of Gattinger.

Like Asa Gray, Weatherby entered the botanical field at a comparatively late age. Whereas Gray's previous background had been in mineralogy and medicine, Weatherby's had been in languages and literature. But both were eminently successful in botanical work, which became their chief interest. I have given only an inkling of the subjects he published upon; one has but to look through any volume of the Fern Journal and there are the book reviews, notices, and often longer articles on the ferns of tropical America. The bibliography assembled by Professor Fernald and Miss Schubert consists of 300 titles arranged year by year.

It is natural that he should have achieved a wide reputation and many honors in various fields of botany. He was one of the leaders in the Connecticut Botanical Society and largely responsible for the admirable "Catalogue of the Flowering Plants and Ferns of Connecticut." At the Gray Herbarium he was Assistant Curator in 1931, Senior Curator in 1937, and retired in 1940 as Research Associate. Also he was a member of the British Pteridological Society, and an honorary member of the British Society for the Bibliography of Natural History, Councillor of the American Academy of Arts and Sciences, an editor of the American Journal of Botany, and Chairman of the Committee on Nomenclature of the Botanical Society of America, President of the American Society of Plant Taxonomists, and an editor of "Brittonia." At meetings of the International Botanical Congress to be held at Stockholm this coming summer, he will be greatly missed; he had been appointed as Vice-President of the Section on Nomenclature. Though in frail health he worked regularly at the Gray Herbarium and all were saddened to learn that he had died suddenly from the effects of a blood clot on the morning of June 21st.

AMERICAN MUSEUM OF NATURAL HISTORY, *New York.*

Charles Alfred Weatherby—Teacher and Counselor

ROLLA M. TRYON, JR.

Among his many contributions to systematic botany one of the most enduring is the wise counsel and kindly advice Mr. Weatherby so generously gave to the students at the Gray Herbarium. He was frequently called upon for help on identification, nomenclature or a troublesome manuscript. He gave freely of his time and a student soon learned the way up the narrow flight of stairs to Mr. Weatherby's desk in the fern room. His ability as a teacher and his willingness to help the beginner increased the demands upon his time many fold.

His qualities as a teacher were based to a large extent upon this objective viewpoint and his keen analytical mind, which enabled him to see the essence of a problem. Students were appreciative of his lucid exposition. He was particularly adept at analysis, a skill well illustrated in his remarks on phyletic classifications in ferns. His published reviews in the Fern Journal on such classifications exemplify the sound and balanced ideas so often expounded in informal discussions. Mr. Weatherby enjoyed teaching. He was perhaps at his best when explaining a complex problem of nomenclature. When a problem had become a maze of entanglements with the Rules of Nomenclature seemingly contradictory, it would be presented to Mr. Weatherby and he would quietly point out the various important elements and arrange them in a clear and understandable sequence. Not only was the application of the Rules elucidated but the reasons for them and frequently their historical background explained as well.

The art of monography is a difficult one for a student to master and an equally difficult one to teach. There is no set of printed rules, no text or handbook to guide the student or furnish the professor with a basis for organized lectures. The traditional styles of form, abbreviations and idioms in several languages all carry precise and special meanings. There are diverse concepts of taxonomic categories and many ways of presenting these concepts. This unwritten code is not only difficult to teach in itself but individual matters must be explained as they arise in a student's work and these are rarely encountered in a related order. Mr. Weatherby was eminently suited to teach such material from his extensive knowledge of the literature and of the theory and practice of systematics. He was pre-eminent in his patience with a student—a patience that was never tried by repetition. He was tolerant of the views of others. A student was allowed all reasonable latitude in expressing his own views and preferences in his work; the intellectual integrity of the student was always respected.

His work was principally on the ferns, but by no means restricted to them, for he was interested in the systematics of many groups and early in his career had become an authority on the flora of New England. He closely followed research in the fields of morphology, plant geography, evolution, and particularly cytology, genetics and anatomy as they related to systematics. Art, current politics, education, law, economics, mechanics, literature, music, and military and political history engaged his attention and counterbalanced his specialized studies. These broad interests enabled him to retain a remarkably clear and objective view toward his subject. Of perhaps most importance are the high standards of scholarship that Mr. Weatherby set for himself in his own work. Again, he was tolerant of those with lesser standards or attainments, but a student inevitably gained from this example. His chosen profession will continue to benefit as these standards are preserved and fostered by the many students who were among the fortunate to have had his counsel.

MISSOURI BOTANICAL GARDEN.

A Personal Tribute to Charles Alfred Weatherby

IRA L. WIGGINS

The biographers[1] have presented such excellent biographical sketches of the late Charles Alfred Weatherby that it would be futile for one who had enjoyed association with Mr. Weatherby for only brief and infrequent periods over a span of about twenty years to attempt a further evaluation of his accomplishments in taxonomic botany. But it is my desire to present a note of appreciation of some of the characteristics that made him one of the most respected and beloved of American botanists.

Many of us, probably, relive in our memories some particular experience, or recapture a mental image of a specific scene when the name of a friend is mentioned. Thus, when I think of Mr. Weatherby there are two scenes that stand out sharply among those passing kaleidoscopically before my mind's eye. One recalls an afternoon in the Gray Herbarium when patiently, thoroughly, and with consummate bibliographic skill he helped me trace the complicated nomenclatural history of a much disputed species through a score of books and journals. His remarkable memory enabled him to sift and sort bits of evidence, taking a phrase from one source, a part of a description from another, a reference to a specimen or a different publication from a third—constantly weighing, evaluating, discarding and reassembling the pertinent facts until each piece of the jigsaw puzzle was maneuvered into its proper place. Then, with a precision and decisiveness that was, to me, simultaneously cause for despair and great admiration, he recapitulated the whole case, setting forth each step in faultlessly logical sequence! He had been under no obli-

[1] M. L. Fernald. Charles Alfred Weatherby, Botanist and Helper of Botanists (with Portrait). Rhodora 51: 109–179, 1949, and H. K Svenson, THIS JOURNAL.

gation to contribute so generously of his time, energy and knowledge. He did it because he possessed an endless supply of patience, tremendous kindliness, and a sincerely genuine desire to aid anyone working with plants and about whose problems he had any knowledge. He taught me, that afternoon, things about solving nomenclatural problems that have been of inestimable value to me on many, many occasions since.

The other outstanding scene connected, in my memory, with Mr. Weatherby is placed in a small but famous inn on one of London's older streets. He had invited me to join him and Mrs. Weatherby on a visit to this delightful little place, "Ye Cheshire Cheese," one evening in July, 1937. He knew more about the history of the establishment than did the waiter who pointed out the table at which Ben Jonson is reputed to have sat while partaking of the cheese pie still featured by Ye Cheshire Cheese. Indicative of Mr. Weatherby's kindliness was the care with which he refrained from reporting his anecdotes concerning the place, obviously unknown to the waiter, while the latter was within hearing.

As we sat around the massive oak table enjoying the food, admiring the sheen on the smoke-darkened beams of the ceiling, and speculating about the men both great and small who had foregathered there since London's Great Fire, we forgot, for a few golden moments the puzzles involved in plant taxonomy and the tension that even at that time was building up in Europe and which exploded into war a short two years later. Of course our conversation finally swung back to botany. Mr. Weatherby talked about the lines of demarcation between species in *Pellaea, Cheilanthes* and *Notholaena.* He remarked that he was not at all satisfied with the status of things in the last genus, and that perhaps sometime he would study critically the species assembled under that generic heading. It was not apparent from his conversation that he was already working on some of the puzzles involved in *Notholaena,* although I did note a slight smile that flitted across Mrs. Weatherby's features when he said "sometime he might" study the group! (The outcome of some of those studies appeared in print in the form of three papers, one published jointly with Dr. W. R. Maxon,[2] and two[3, 4] under his own authorship, in 1939, 1941, and 1943, respectively.)

Next, our discussion drifted to the species of *Selaginella* represented in the arid portions of the southwestern United States and adjacent Mexico. His knowledge of the structure, growth habits, general range and even of exact localities where the various species had been collected was detailed to an amazing degree. Yet he urged that if the opportunity presented itself I set some brilliant graduate student to work on the group. He thought that intensive study of the group by someone living in the west, and able to do extensive field work, accompanied by study in the herbarium and greenhouse, would repay richly the effort devoted to the project.

When we emerged from the subdued light of "Ye Cheshire Cheese" London was bathed in the twilight characteristic of midsummer in high latitudes and Mr. Weatherby suggested that we walk through some of the older sections of the city rather than board a bus or descend into the "tube." The hour that followed was unforgettable. Mr. Weatherby was thoroughly familiar with dozens of points of historical interest and called attention to unobtrusive plaques, many of which might

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[2] Some Species of Notholaena, New and Old. Contributions from the Gray Herbarium No. 127[1]: 3–17, 1 fig., 1939.

[3] The Argentine Species of "Notholaena." Lilloa **6**: 251–275. pls. 1–4, 1941.

[4] The Range of Notholaena delicatula. Amer. Fern Journ. **33**: 27–28, 1943.

have been overlooked by one unfamiliar with the city, marking the sites of famous structures or the scenes of episodes in English history. Mrs. Weatherby contributed comments on particularly beautiful or unusual architectural gems, the intriguing wrought-iron gates closing off some of the doorways, and on the variety in design displayed by the chimneys that lend a distinctive note to London's skyline. Mr. Weatherby voiced regret that Westminster Abbey was closed during extensive repairs. His regret was not for himself, for he knew the beautiful edifice intimately, but because his guest, being newly arrived in England, would be unable to share with him and Mrs. Weatherby their delight in the majesty and dignity of the structure. He urged me to take a couple of days to visit Winchester and its massive cathedral, the Great Hall in which King Arthur's huge circular table is housed, and the mediaeval gate to the old walled part of the city. He quietly observed that no matter how intense might be one's interest in botany a recreational jaunt during which one contemplated historical landmarks, architectural masterpieces and charming countryside could easily bring high satisfaction and renew one's zest for rigorous attention to business after the holiday.

Throughout the long, leisurely evening Mr. Weatherby was instructing, guiding, advising me with such tact and complete friendliness that it was not until weeks later that, in taking stock of my sojourn in England, I realized how much he had taught and helped me. Adroitly he had woven helpful comments on difficult taxonomic problems into the conversation, a conversation that seemed at the time to be quite general. The aid he gave me that afternoon and evening has been of great and continuing value. Would that I might have been privileged to spend many other quiet afternoons with him!

At various times since 1937 Mr. Weatherby has looked up references in publications not available on the Pacific coast, given me advice about knotty taxonomic or nomenclatural problems, has arranged for the photographing of type specimens, and has suggested improvements in manuscripts being prepared for publication. From among these many favors I select one of the more recent ones as typifying his thoughtfulness and his devotion to the causes of accuracy, critical appraisal, and complete objectivity in taxonomic botany. I had written asking about the original descriptions of *Blechnum spicant* (L.) J. Smith, forma *bipinnatum* Clute, and of forma *serratum* (Druery) Broun. He wrote me a typically lucid and detailed account of the nomenclatural history of forma *bipinnatum*. He explained that Clute's early handling of the epithet had been rather difficult to understand, but that in a later paper Clute had helped matters, for in it ". . . . he gives some two pages of comment and a sketch which should show you exactly what he had." Then, Mr. Weatherby added a sentence that epitomizes his generosity and his devotion to cooperation among botanists and to accurate work based on original sources. He wrote, "As I gather that you do not have a set of the Fern Bulletin, I am having this photographed for you, with the comment, and will send it to you as soon as the prints are ready."

There had been no hesitancy on his part about photographing the article even though no request for such a favor had been made. Nor would he ever admit that there had been any personal expense connected with the photographic work or accept remuneration for the prints.

Truly, our knowledge of ferns and their allies, to say nothing of that of other plants, and nomenclatural problems has been advanced greatly by the efforts of Charles Alfred Weatherby. Hundreds of his fellows have been encouraged, cheered, and inspired by his kindness, generosity, and sterling integrity. His wisdom has contributed much during deliberations dealing with taxonomic and nomenclatural subjects. He was a gentleman and a scholar in the finest sense of each word. Now that we who have known, respected, and loved him no longer can turn to his wisdom for immediate aid we feel the loss keenly. But as long as we continue to work with plants —as long as we remember his advice and counsel—we will continue to hold in high esteem the memory of Charles Alfred Weatherby.

DUDLEY HERBARIUM, *Stanford University.*

Additions and Corrections to the Genera Filicum

E. B. COPELAND

So far as I know, Mr. C. A. Weatherby never made an error in one of his publications. All the rest of us who have published at all extensively have made mistakes of record. When this happens, we are fortunate if we can correct our mistakes ourselves. So now, two years after the publication of my Genera Filicum,[1] I would like to correct the mistakes which have come to my attention, and to add a few notes concerning some recently proposed names and some others which were overlooked.

On page 23 the statement is made that the sporangia in *Actinostachys* are in 4 rows instead of in 2, as in the other subgenera of *Schizaea*. Selling[2] has described two species (*Schizaea inopinata* and *S. Wagneri*) in which the sporangia are in only 2 rows.

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[1] Published by Chronica Botanica Company, as Volume 5, Annales Cryptogamici et Phytopathologici. 1947. Reviewed by C. A. Weatherby, Amer. Fern Journ. **38**: 7. 1948.

[2] Svensk Bot. Tidskr. **40**: 274, 280. 1946.

On page 28 I recognized the genus *Hicriopteris* as a segregate from *Gleichenia.* Christensen had suggested this earlier and Ching[3] had formally revived the genus. In 1941 and 1947 he proposed the following new combinations: *H. glauca* (Thunb.) Ching, *H. laevissima* (Christ) Ching, *H. Blotiana* (C. Chr.) Ching, *H. Norrisii* (Mett.) Ching, *H. volubilis* (Jungh.) Ching, *H. bullata* (Moore) Ching, and *H. Bancroftii* (Hook.) Ching. All of these antedate my own combinations of the same names.

On page 51 the following is to be inserted as a synonym of *Microlepia:*

Coptidipteris Nakai & Momose, Cytologia Fujii Jub. Vol. 365. 1937 (not seen); Ito, Fil. Jap. Illustr. 12. 1944.

The sole species is *C. Wilfordii* Nakai & Momose, a synonym of *Microlepia Wilfordii* Moore.

On page 112 I wrote concerning the geographic distribution of the genus *Cyclopeltis* that I mistrusted the label on the only specimen that I had seen ascribed to Mexico. Mr. Weatherby wrote me that the Gray Herbarium contains three specimens of *Cyclopeltis* from Chiapas and Tabasco, Mexico.

On page 113 the following two generic synonyms are to be added to *Rumohra:*

Arachniodes Blume, Enum. Pl. Jav. 241. 1828.

This is typified by *A. aspidioides* Blume, which is said to be *Rumohra aristata* (Forst.) Ching. If the several critics who deny the generic affinity of *R. adiantiformis* (the type of *Rumohra*) and *R. aristata* are correct, then *Rumohra* is monotypic, and the proper name of the genus of about 60 species is *Arachniodes.*

Acrorumohra Ito, in Nakai, Nov. Pl. Jap. no. **4:** 101. 1939; Fil. Jap. Illustr. 291. 1944.

[3] Sunyatsenia 5: 278. 1940.

The sole species, *A. diffracta* (Baker) Ito, is a synonym of *Rumohra diffracta* Ching, Sinensia 5: 69. 1934.

On page 131 in the discussion of the genus *Luerssenia* I commented that I had never seen a record of this fern since the original collection from Lankat, West Sumatra. Holttum[4] reports that it was collected by Kloss on Sipora Island.

On page 132 I discussed the typification of the genus *Anapausia* Presl,[5] but without coming to any definite conclusion. The name was first applied[6] to a section of *Gymnopteris,* the first species mentioned being *G. Wallichiana* Presl. In raising this section to generic rank Presl cited first the species *A. decurrens* (Blume) Presl, citing *Gymnopteris Wallichiana* Presl as a synonym. Accordingly *A. decurrens* may be accepted as the type of the genus. Therefore, *Anapausia* becomes the correct name for the genus I described as new on page 198 under the name *Paraleptochilus,* the type of which is also *Leptochilus decurrens* Blume.

On page 140 an additional synonym to be inserted under *Cyclosorus* is the following:

Pneumatopteris Nakai, Bot. Mag. Tokyo **47**: 179. 1933.

The sole species is *P. callosus* (Blume) Nakai, a synonym of *Cyclosorus callosus* (Blume) Copel.

On page 146 the following should be inserted as a synonym of *Cystopteris:*

Acystopteris Nakai, Bot. Mag. Tokyo 47: 180. 1933.

The sole species is *A. japonica* (Luerss.) Nakai, a synonym of *Cystopteris japonica* Luerss.

On page 157 the following should be added to the paragraph concerning *Diploblechnum* (a synonym of *Blechnum*): The type of the genus is *Blechnum integri-*

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[4] Journ. Malay. Branch Roy. Asiatic Soc. 6: 21. 1928.

[5] Presl, Epim. Bot. 185. 1849.

[6] Presl, Tent. Pterid. 244. 1836.

pinnulum Hayata,[7] the Formosan form or representative of *B. Fraseri*.

On page 157 the following should be added to the paragraph on *Blechnidium* (a synonym of *Blechnum*): Ching[8] has reported some collections from Yunnan and has found several reasons for maintaining this genus as distinct from *Blechnum*.

On page 164 the following should be added to the synonyms of *Asplenium:*

Cetarachopsis Ching, Bull. Fan Mem. Inst. Bot. **10**: 8. 1940. Cfr. also page 169.

Two species are referred to the genus: *C. paucivenosa* (Ching) Ching, based on *Ceterach paucivenosum* Ching, and *C. Dalhousiae* (Hook.) Ching, based on *Asplenium Dalhousiae* Hook. (*Ceterach Dalhousiae* C. Chr.). The latter is the species of this relationship occurring in Arizona.

On page 188 the following should be added as a synonym of *Neocheiropteris:*

Neolepisorus Ching, Bull. Fan Mem. Inst. Bot. **10**: 11. 1940.

The type is *N. ensatus* (Thunb.) Ching, a synonym of *Neocheiropteris ensata* (Thunb.) Ching; five other species of the genus are recognized by Ching.

On page 205 in the discussion of *Lecanopteris* the species *L. sinuosa* is spelled correctly once but is twice misspelled *L. sinuata*, as it is also in the Index. My attention was called to these errors by Director Holttum.

On page 210 I proposed the new genus *Polypodiopsis*. Reed[9] points out that the name *Polypodiopsis* was used by Carrière[10] for some mysterious plant of New Caledonia. Accordingly, he proposed the substitute name

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[7] Icon. Fl. Formosa 4: 236. fig. 165. 1914.
[8] Bull. Fan Mem. Inst. Bot. 10: 4. 1940.
[9] Amer. Fern Journ. 38: 87. 1948.
[10] Conif. ed. 2, 710. 1867.

Polypodiopteris, and makes the corresponding new specific combinations. Reed[11] would also replace *Crepidopteris* Copel. by *Crepidophyllum* Reed, on the ground that my name *Crepidopteris* was invalidated by the use of the same name by Bentham.[12] Bentham, *in synonymy*, did print "*Crepidopteris brasiliensis* Walp.," but this was a miscitation, obviously accidental, of *Crepidotropis* Walp.[13] It does not seem to me to invalidate my use of *Crepidopteris*.

On page 224 I stated that the gametophyte of *Antrophyum* seemed to be unknown. It was shown by Troll[14] to be of the type of its family. Mrs. Giauque has confirmed this for two other species.

On page 232 the following generic synonym should be added to *Azolla:*

Rhizosperma Meyen, Reise **1**: 337. 1834.

The publication of the new genus *Negripteris* Pichi-Sermolli[15] reached me before the publication of the Genera, but after the inclusion of new material became impractical. The genus, typified by *N. scioana* (Chiov.) Pichi-Sermolli (based on *Mohria scioana* Chiov.), is characterized by having the frond form of typical *Cheilanthes* with narrow base, the "farinose powder" of *Aleuritopteris*, the absence of a stomium, and the thickening of all walls of the cells of the annulus, which prevents the forcible discharge of the spores. The structure and behavior of the sporangium are the chief features which moved Pichi-Sermolli to establish a new family, Negripteridaceae, for this fern. The affinity, as well as resemblance, to *Cheilanthes* and *Aleuritopteris* (*Sinopteris*) was fully appreciated. But, as Mr. Pichi-Ser-

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[11] *loc cit.* 88.
[12] In Mart. Fl. Bras. **15**[1]: 166. 1859.
[13] Linnaea **14**: 296. 1840.
[14] Flora **126**: 371. 1932.
[15] Nuovo Giorn. Bot. Ital. **53**: 129–168. pl. 14–16. 1946.

molli wrote, "The last word will however only be said after a complete revision of all the genera of Cheilantheae, which, as usually construed, are certainly neither naturally nor conveniently classified." And now we have lost the man best qualified for such a revision.

UNIVERSITY OF CALIFORNIA.

The Habitat of Diellia

W. H. WAGNER, JR.

The Hawaiian fern genus *Diellia* has been beset with problems for the taxonomist and morphologist for many years. Doubts have been expressed repeatedly by various authorities as to whether its "species," eight in all, have any real validity. Its generic relationships have been interpreted as being with the pteroid ferns (especially *Lindsaea*), the davallioid ferns (*Davallia, Humata,* and *Nephrolepis*), and more recently with the asplenioid ferns, *Asplenium* and *Loxoscaphe.* These wide discrepancies in interpretation have been based on the sorus structure, the frond habit, and scales.

Underlying these problems has been the excessive scarcity of materials of this genus in herbaria, and in nature. It is generally believed to be on the verge of extinction. Modern, complete collections are few, and most of our ideas of the diversity within the genus are based on isolated fragments collected in the period 1850–1880. The most recent attempt to study *Diellia* was made by the late Dr. Frances G. Smith whose report was briefly reviewed by Mr. Weatherby.[1] Dr. Smith concluded from her lack of success in finding materials in the field and in aligning what specimens did exist in herbaria that the problems of this genus might never be

[1] This JOURNAL 25: 103, 104. 1935.

settled and that *Diellia* was dying out.[2] Therefore, in 1947 and again in 1949, investigations of this genus were made under auspices of the University of California Department of Botany with the cooperation of Dr. H. St. John of the University of Hawaii and Miss Marie C. Neal of the B. P. Bishop Museum. Dr. H. L. Lyon has kindly contributed considerable information. In view of the rarity of the genus, it is believed that this summary of results in getting information on its occurrence in nature will be a contribution to our knowledge of these peculiar Hawaiian ferns.

Few herbarium sheets made before 1900 give localities; of modern ones only few include data complete enough to guide the collector to appropriate habitats. The literature is usually vague or misleading regarding habitats. Brackenridge, who described the genus in 1854, gave for *Diellia erecta* the habitat "in mountain forests of the western division of Maui"; for *D. falcata*, "Kaala Mountains, Oahu . . ., on open and dry rocky ridges; rare"; and *D. pumila*, "Oahu . . ., in the crevices of rocks; rare." In 1867, Mann gave the habitat of *D. Mannii* (as a *Microlepia*) as "Waimea, Kauai, 2000–3000 ft." This species has not been found since 1900, but the altitudes given suggest it was a fern of the arid western "plateau" region of Kauai, well below the rainforest. Support is given this belief by Hillebrand's addition in 1888 of Halemanu, Kauai, as a locality. That this spectacular fern with fronds 4–5 times pinnate and stipes of shiny dark-purple was uncommon even then is suggested by Diel's reference to it only 14 years later as a "Seltenheit Kauais."

For *Diellia Alexandri* (as *Davallia*) Lidgate in 1873 gave "Haleakala, 3,000 to 4,000 ft," and Hillebrand

[2] Diellia and its variations. B. P. Bishop Museum Occ. Papers 10, No. **16**: 1–22. 1934.

(calling it *Lindsaea*) later added "northern slope." But to the investigator seeking the exact spot, it would have been necessary to refer to a popular book, "Alóha!", published in 1879 by A. L. Chaney. Here, in discussing the prevalent sport of the day—fern-hunting—the writer revealed the exact gulch (p. 253). Further habitat notes on *D. pumila* are confusing: Bailey said it grew on the "damp side of gulches" in 1883, and Hillebrand in 1888 called its habitat "exposed cliffs." Rock in 1913 said that "*Diellia* has several species peculiar to Kauai, as *D. centifolia, D. laciniata,* and *D. Knudsenii,* which belong to the swampy region." MacCaughey in 1918 included *Diellia* in his third class, "species which are characteristic of the middle forest zone—the rain-forests on the mountain slopes which lie between 1800 and 3000–5000 ft." *D. erecta* was in his fourth class, "a region of torrential rain," but *D. pumila* and *D. falcata* were "distinctly xerophytic." These conflicting reports actually give no real picture of the habitat of *Diellia.* For some of them there is no evidence at all. It is my belief that all of the "species" of this genus occur or occurred in the same basic type of habitat. This is concluded from a study of ten localities on four islands, and a compilation of what accurate data are on labels. Only one description of a habitat known to me gives a clear picture, that of C. G. Munro on the island of Lanai, quoted by Smith. A general description of the occurrence of *Diellia* follows.

Diellia is endemic to the larger Hawaiian islands. A fern named in this genus, *D. Brownii* E. Brown from the Marquesas has since proved to be a *Nephrolepis.* Using a broad species interpretation and construing *D. erecta* to include such forms as *D. Alexandri, D. pumila, D. centifolia,* and *D. laciniata,* then it is a polymorphic species known from the islands of Kauai, Oahu, Molokai,

Typical Diellia habitat, Mahanaloa Valley, Kauai

Lanai, Maui, and Hawaii. On Kauai *D. Mannii* (including *D. Knudsenii* as the juvenile form) and an apparently undescribed species found in 1947–49 are both endemics. Oahu has the one remaining species, *D. falcata,* as an endemic. Localities known today range in altitude from 1250 to 3700 ft. All of the stations are in more or less arid regions. Comparison with maps of isohyet lines of the islands shows that annual rainfall at *Diellia* localities ranges from about 35 to 80 inches. Temperature estimates based on Weather Bureau records from stations at different altitudes would range from 70° to 62° F. with increasing elevation. Many of the localities lie in Ripperton and Hosaka's "Zone C," an area running to a maximum of 4000 ft., with a natural cover of "Mixed open forests and shrubs." Two stations on Molokai and two on Maui are in their "Zone D," an area of shrub and closed forest with 60 or more inches of rain. Most localities are on lee sides of mountains, and those facing northeast toward the trades are protected by other mountains lying windward which cut down rainfall.

Within these relatively arid regions, this genus is confined usually to steep gulch sides (*Pl. 2*). In numbers of plants, a given locality may have from one or several to thousands, but the populations are always local or "spotty" and usually small. The plants are inconspicuous and resemble casually such ferns as *Nephrolepis, Asplenium,* and *Doodia.* A typical gulch or canyon where *Diellia* occurs is one with sides more or less wooded or shrub-covered and sloping from nearly vertically to about 30° or 40°. The stream bed at the bottom is usually dry or at least without flowing water most of the year. In all cases the soil is somewhat rocky, the particles of rock ranging in size from less than a centimeter to three or four feet in diameter.

ABOVE: DIELLIA ALEXANDRI, GROWING ON SHADED ROCK SHELF, E. MAUI (PHOTOGRAPH BY JOHN B. BONSEY)
BELOW: DIELLIA FALCATA, GROWING ON OPEN SOIL, OAHU (PHOTOGRAPH BY CHARLES E. ST. JOHN)

Plants are commonly found growing directly on rock surfaces (*Pl. 3*) in crevices or ledges, or on open soil (*Pl. 3*). The rock is mostly of a soft *aa* type. The soil reaction in all such places tested (with a LaMotte Soil "Teskit") was of pH 7.0–8.0. When the plants grow directly on soil, this is always loose, dry, and granular, i.e. tends to hold together in small lumps. It appears to be well aërated, with quick drainage.

The plants grow in the shadow of overhead trees or smaller plants. *Aleurites moluccana,* the *kukui; Metrosideros polymorpha,* the *lehua; Psidium Guayava, guava;* and *Acacia Koa,* the *koa,* are commonly associated trees. Others reported are *Pisonia* (Munro) and *Bobea* (Degener). Of smaller plants, *Eupatorium adenophorum,* the *pamakane,* is an especially common provider of shade for *Diellia erecta* and its forms on Molokai and in east Maui. On Oahu a coarse grass, *Eragrostis* sp. (*Wagner* 5801) provides shade on open hillsides of the western side of the Waianae Range for a tiny form of *Diellia.* In no case were plants found exposed to full sunlight.

Where *Diellia* occurs a variety of other ferns, to be discussed, as well as flowering plants make up the understory. Toward the bottoms of the gulches the understory becomes increasingly dense as the amount of soil water increases and shade becomes deeper. In the gulch bottoms themselves such ferns as *Athyrium* spp. and *Pteris excelsa,* not found on the slopes, form dense ground covers. At the tops of the slopes, on the contrary, the situation is usually so dry and exposed that few ferns other than bracken are found. *Diellia* usually exists between these extremes, and the level on the sides of gulches at which its species attain their best development is usually in a broad horizontal band with its center line halfway up the slope. Juvenile plants are often seen, and occasionally adults, on rocks or soil banks

(*Pl. 4*) at the bottoms of gulches where these are rather open, but it was discovered that if one climbed the slopes (mostly north-facing ones) from 20 to 150 feet above these plants that more numerous and older individuals would be revealed.

All of the habitats showed disturbance, and this appears to be very important. Although plants were frequently seen on bare or slightly mossy rock surfaces of relatively permanent boulders or rock outcrops (*Pl. 3*), all plants on soil surfaces were found in disturbed places and were apparently temporarily free from competition of the other understory plants. Presumably in most of these places the common understory plants will ultimately return and crowd out *Diellia*. One of the largest colonies of this genus found at Puu Kolekole, Molokai, grew on a steep rock-slide which probably originated in the last decade. *Eupatorium adenophorum* has since established itself on the "slide" and provided shade for plants of *Diellia*. A similar but much more recent "slide" or avalanche, of about 15 by 30 feet, was near by, but no plants had yet made a start here. Situations at Paaiki and Mahanaloa Valleys, Kauai, and Haleanu Gulch (*Pl. 4*), and Pohakea Pass, Oahu, similarly showed a greater or lesser movement of rocks and soil down the steep slopes—a movement which is constantly going on sporadically and which exposes small areas of soil and rock surface. The unsettled nature of these places is such that the collector must often hold on to branches and roots of trees so as not to slide down the slope along with the readily dislodged rocks and soil. Situations like this in the primeval Hawaiian canyons very likely provided the new soil surfaces, small areas temporarily free of other understory vegetation, which these plants seem to require. Likewise, old and crumbling *aa* lava flows such as those at Manuka, Kau District, Hawaii, where G. W. Russ found this plant, offered natural habitats for *Diellia*.

In modern times, however, new surfaces may be cleared off locally by activities of cattle or goats, or by maintenance of foot- or horse-trails in wooded gulches. A number of collections illustrate this: Dr. H. L. Lyon kindly informed me that cattle paths traversed the area where he found *Diellia falcata* at Makaleha, Oahu. A specimen of C. G. Munro from Lanai of *D. erecta* (B. P. Bishop Museum) is labeled "near waterhole," and a collection of Degener and Topping from near Kawaihapai, Oahu, is labeled as coming from "moist rocks in arid woods near watering trough." In the period when most of the collections of this genus (*D. Mannii, D. laciniata, D. Alexandri, D. centifolia, D. Knudsenii*) were made around Halemanu, Kauai, by Knudsen about 1875, cattle were numerous there, and travel was made along horse-trails. It seems very probable that this enabled *Diellia* to grow at that time in the ravines there, in places now once again grown over since the cattle were removed years ago. More permanent native vegetation as well as various exotics have now crowded out *Diellia* at Halemanu and Kokee. At Piiholo, Maui, and Puu Kolekole, Molokai, cattle and goat trails criss-cross along the slopes and the majority of the plants found at these places occurred under these disturbed conditions. At two spots near Puu Kolekole where fences cross the wooded or shrubby gulches obliquely, trails of cattle and goats following the fences toward water-holes at the gulch bottoms increased to a large number and here plants were very numerous, especially immature ones (*Pl. 4*). Maintaining foot-trails through wooded gulches has the same effect. At Kahuaawi Gulch, Molokai, the only large plants seen were on low boulders just beside a foot-trail which had been kept up for nine years; a

Sporelings of Diellia erecta on dry dirt bank, Molokai careful search in the understory nearby revealed no *Diellia,* apparently because the ground cover of *Nephrolepis* (particularly) and other ferns and flowering plants was too dense.

Thus, temporarily disturbed areas have proved to be the usual habitat, and the sources of this disturbance are in the following categories: (1) by natural rock slides or avalanches, and decaying *aa* flows, (2) by destruction of understory cover and induced rock slides (a) from domestic or feral animals, and (b) by man-made trails.

Usually other fern genera are not growing immediately with *Diellia,* but a number of ferns regularly occur near it. I found it convenient to use these associated ferns as "indicators" in seeking localities for *Diellia,* with recognition of possible fallacies in such a procedure. These ferns were *Nephrolepis exaltata, Doodia Kunthiana, Doryopteris* spp., *Asplenium Macraei, A. Adiantum-nigrum, Phanerophlebia caryotidea, Microlepia strigosa,* and the *Pteris cretica* complex. The ubiquitous *Psilotum nudum* is almost always near by, and such spleenworts as *Asplenium unilaterale, A. horridum, A. enatum, A. contiguum,* and *A. acuminatum* are occasionally on the same slopes. Each of these ferns, to be sure, has its own specific tolerance ranges for factors of the Hawaiian environment: for instance, while *Nephrolepis exaltata* and *Asplenium unilaterale* extend into the wet forest, *A. Adiantum-nigrum* and the species and forms of *Doryopteris* are confined strictly to the arid regions. *Asplenium Macraei, Phanerophlebia caryotidea,* and the group of *Pteris cretica* seem to approach *Diellia* the most closely. Somewhere in the complex overlap of the various environmental requirements of all these ferns listed is the typical physiological situation for *Diellia,* and I believe that any situation possessing the physical features described earlier, and supporting most of the ferns listed above, should be investigated as a likely habitat for this genus anywhere in the Hawaiian Islands.

From this summary it may be concluded that the habitat of *Diellia* is a transient one, both edaphically and biotically, which occurs constantly but sporadically, both in time and area, through the steep and dryer wooded gulches of the Hawaiian Islands. It may be surmised that the apparent rarity of the genus is due to the relatively small areas that such suitable environments occupy at any one time. The "disappearance" of the genus from some of its former localities may be due to the removal of disturbing influences which provided appropriate edaphic and biotic conditions. On the face of present evidence it does not follow that the genus is "on the verge of extinction." Because its habitat is transitory, it has probably always been rare and local! Further field research may even reveal that *Diellia Mannii* still exists somewhere in western Kauai.

DEPARTMENT OF BOTANY, UNIVERSITY OF CALIFORNIA.

The Problem of Generic Segregates in the Form-Genus Lycopodium[1]

BERNARD BOIVIN

During the academic year of 1947–8, it was my privilege to work under the guidance of the late Mr. C. A. Weatherby as Harvard Research Associate and as a scholar of the John Simon Guggenheim Memorial Foundation. Those of us (nearly every North American Botanist) who have worked with or under Weatherby or who have at one time or another asked him for help or

[1] Contribution No. 1002 Division of Botany and Plant Pathology, Science Service, Dominion Department of Agriculture, Ottawa, Canada.

advice can readily appreciate the advantage that was mine. While working on *Lycopodium,* I was able at any time to discuss problems with him, or draw upon his astounding knowledge of the botanical literature, or have his opinion on unusual problems in nomenclature. That I considered him as a friend and myself as his disciple goes without saying.

The genus *Lycopodium,* described by Linnaeus, has been subjected to the repeated attempts of later authors to subdivide it into more manageable and homogeneous genera. The first attempt was by Bernhardi[2] who proposed two new segregate monotypic (in 1801) genera: *Tmesipteris* Bernhardi and *Bernhardia* Willdenow. Both new genera were immediately accepted, but *Bernhardia,* Willd., being a later homonym, was replaced by *Psilotum* Swartz in 1806.

In 1804, Palisot de Beauvois published in the Magazin Encyclopédique a paper entitled "Prodrome de l'Aethéogamie" in which six more generic segregations were proposed. For the genus *Lycopodium,* in the modern sense, he set up two new genera: *Plananthus* Beauvois and *Lepidotis* Beauvois; and for *Selaginella,* in the modern sense, four new genera: *Diplostachium* Beauvois, *Gymnogynum* Beauvois, *Selaginella* Beauvois, and *Stachygynandrum* Beauvois. As for *Lycopodium* L., the name itself was discarded altogether. In the following year Beauvois published separately a paper entitled "Prodrome des Cinquième et Sixième Familles de l'Aethéogamie," which comprised a reprint of the earlier paper plus a list of the transfers necessitated by the new genera.

The proposals of Beauvois were entirely ignored until thirty-three years later when A. Spring revived one of Beauvois' genera, the monotypic genus *Selaginella,* as

[2] Journ. für Bot. **1800**[2]: 131–133. 1801.

the name for the largest part of what was then called *Lycopodium* L. For years Spring published abundantly on *Selaginella*, and, after the appearance of his monograph of the genus in 1850, this new segregate genus became universally accepted.

There were a few more attempts, mostly half-hearted ones, to set up new segregates for *Lycopodium*. In 1900, E. Pritzel published the subgenus *Urostachya* Pritzel,[3] which was later raised to generic rank as *Urostachys* by W. Herter and accepted as such by H. Nessel in his monograph of *Lycopodium*, "Die Bärlappegewächse," published in 1939.

Herter's proposal failed, without any justification, to take into account the fact that *Urostachys* lacks the essential character of priority over many other previous names, especially *Plananthus* Beauvois. This and other defects, such as the lack of Latin descriptions, erratic bibliography, and unusable keys, greatly diminish the usefulness of Nessel's monumental monograph.

The advisability of separating further segregates from *Lycopodium* has been the subject of much of my work during the years 1947–1948, yet I have been up to now unable to reach a satisfactory decision. From the point of view of the phylogenist and the morphologist, *Lycopodium* L. should probably be divided. The reasons advanced are based almost wholly on the structure of the gametophyte. True, the gametophytes of most species of *Lycopodium* are still unknown, but those known fall into neat and fairly homogeneous groups and show a remarkably wide range of variation, from primitive types to the most highly specialized forms to be found in the ferns and fern allies. From the point of view of phylogeny, it is somewhat disturbing to see both primitive and highly specialized types of gametophytes within the genus *Lycopodium*.

[3] In Engl. & Prantl, Natür. Pflanzenfam. 1⁴: 563. 1900.

To the field and herbarium taxonomist, characters drawn from the gametophyte are highly impractical, to say the least. Few plant collectors have ever found gametophytes of *Lycopodium,* and such gametophytes are difficult to identify unless the possible species are few in number, are already well known, and may be growing in the vicinity. Not that gametophytes are extremely rare; to be sure, they are not as frequent as full-grown sporophytes, but they are extremely difficult to detect.

If the gametophyte of *Lycopodium* suggests a heterogeneous genus, the sporophytes are on the other hand strikingly similar in appearance. The only characters of possible generic value in the sporophyte of the present-day *Lycopodium* are: the shape of the sporophylls, the mode of growth, and the method of vegetative propagation—surely very weak characters on which to separate genera. From a practical point of view, the shape of the sporophyll is almost always observable in dried specimens, but the mode of growth is not always obvious and only rarely indicated on the labels.

Below is given a contrasted summary of the characters on which segregates of *Lycopodium* could be based.

I. GROUP OF L. SELAGO L.

HABIT: Terrestrial plants, erect at the tip, decumbent and rooting below; bulblets borne on reduced branches often present in this group, always absent in others; branching strictly isodichotomous, all branches being symmetrical and functionally alike. Growth is indefinite, innovations being present, with groups of sporophylls alternating with groups of leaves, one group of each being produced each growing season.

SPOROPHYLL: Much resembling the leaves in appearance, but usually slightly smaller, sessile or petiolulate, with the sporangium born near the base of the blade.

GAMETOPHYTE: Elongated, simple, entire or sometimes with two short branches, dorsiventral, flattened, with a distinct complete or incomplete rim; rhizoids scattered on the underside; antheridia and archegonia scattered on the upper surface within the rim;

epidermis fairly well differentiated and one-layered; fungal tissue multilayered and occupying the whole of the lower half of the tissue of the gametophyte. No further cell differentiation is present, except for a vaguely delimited and differentiated storage tissue of somewhat larger cells, located immediately above the fungal tissue.

II. GROUP OF L. PHLEGMARIA L.

HABIT: Epiphytes, tufted, loosely hanging; branching strictly isodichotomous, all branches being symmetrical and functionally alike. Growth is usually definite, and arrested after the production of the first group of sporophylls; then, innovations are absent and all the leaves are below the sporophylls. But growth is occasionally indefinite in some species and always indefinite in at least one species, in which case the sporophylls and leaves are in alternating groups, as in *L. Selago* group. New stems arise from the base of the old ones (and probably adventitiously).

SPOROPHYLL: Similar to the sporophyll in the *L. Selago* group, but in many species much smaller than the leaves, the strobiles thus often being distinct.

GAMETOPHYTE: Subterranean, cylindrical, abundantly ramified, not dorsiventral; rhizoids scattered; antheridia and archegonia scattered or in groups among the rhizoids; no internal differentiation of cells; fungal tissue superficial in small scattered patches and in no particular relation to the rhizoids.

III. GROUP OF L. SAURURUS LAMARCK

HABIT: Terrestrial, the stems tufted or single, stiffly erect; branching strictly isodichotomous and growth always definite (See group of *L. Phlegmaria*). The tufted habit results from the stems arising from the base of the old ones, as in group II; if the plants are single, branching is candelabriform in appearance.

SPOROPHYLL: Very similar to the leaves of the *L. Selago* group.

GAMETOPHYTE: Unknown to me, but presumably as in group II.

IV. GROUP OF L. CERNUUM L.

HABIT: Terrestrial; branching heterodichotomous. The erect portion of the plant simple or branched; if branched (*L. cernuum* L.), a main axis is present with only part of the branches strobiliferous and a lower branch arching over to root at the tip and produce a new erect axis; if simple, the strobiliferous axis is erect (*L. inundatum* L.) and arises from an axis appressed on the ground or arching over, rooting at tip and becoming underground for a short distance. Innovations are absent, each part of the plant living less than a full year, the growth of erect portion being definite, of arching portion indefinite. The strobiles are sometimes indistinct, as in group I (*L. inundatum* L.), sometimes conspicuous and similar to those in groups V, VI, and VII (*L. cernuum* L., *L. carolinianum* L.), being usually sessile or borne on a pseudo-peduncle as in groups V and VI.

SPOROPHYLL: Peltate and inserted near the base on a short stipe; sporangium borne at the junction of the blade and stipe. The sporophylls are sometimes fused laterally (See group VII).

GAMETOPHYTE: Superficial and green, more or less conical, with tapered end pointing downwards, the truncate end bearing numerous lobes; fungal patches sometimes absent, but usually one or more on the tapered part of the gametophyte; rhizoids present only at the fungal areas; antheridia and archegonia located between the bases of the lobes. Internal differentiation of cells is limited in extent, the fungal tissue being one-layered and superficial; behind the fungal layer, a more or less distinct palisade layer is usually present; the innermost cells are often slightly larger; the rest of the cells, actually the greatest number, are small and undifferentiated.

V. GROUP OF L. CLAVATUM L.

HABIT: Terrestrial, with shallowly to deeply buried rhizome of indeterminate monopodial growth and numerous erect epigeous branches of determinate growth; growth of both rhizome and erect stem carrying through more than one season, innovations thus being present on both; strobiles always distinct, sessile or borne on a simple or branched pseudo-peduncle bearing sub-verticillate reduced leaves, this terminating the main axis, the lateral branchlets not being strobiliferous.

SPOROPHYLL: Peltate, as in group IV, and always sharply differentiated from the leaves in size, color, etc.

GAMETOPHYTE: Subterranean, short-conical to bilobed, with the pointed end pointing downwards and the flattened end uppermost; distinct rim present and continuous; rhizoids on the lower part only; antheridia in clusters on the upper side of the rim; archegonia scattered within the rim; no internal differentiation of cells, except for a well developed fungal layer on the underside.

VI. GROUP OF L. COMPLANATUM L.

HABIT: As in group V. Leaves always reduced and more or less fused to the branches and disposed in rows (usually four rows);

pseudo-peduncle always present, sometimes vestigial. Otherwise as in Group V.

SPOROPHYLL: As to group V.

GAMETOPHYTE: Subterranean, conical, constricted just below the capitate upper end, the lower end pointed; rhizoids scattered below the constriction, absent above; archegonia and antheridia densely grouped on the capitate end; no internal differentiation of the cells of the capitate end; cells of the tapered portion in four distinct layers—from outside inward: a usually multilayered epidermis, a multilayered fungal tissue, a unilayered palisade tissue and central storage tissue of slightly enlarged cells.

VII. GROUP OF L. LATERALE R. BROWN

HABIT: Terrestrial, stiffly erect, with underground system of undetermined nature; growth carried through many seasons, but determinate, innovations thus being present; strobiles distinct, borne on short lateral branches.

SPOROPHYLL: As in groups V, and VI, but fused laterally and free at both ends, the sporangia thus being inside a tubular structure. Over each sporangium there is a pore that may be opened or closed by the flexion of the tip of the corresponding sporophyll, the outline of which is still distinct.

GAMETOPHYTE: As in group IV.

Can the splitting of *Lycopodium* into smaller genera be justified from the above? I am in doubt. Certainly the variations encountered in the *gametophyte* are major variations. But variations of the *sporophyte* are decidedly of a minor nature; they provide no sharp divisions and could not by themselves justify splitting *Lycopodium*. Worse, they are poor characters from the taxonomist's point of view, since so much of the identification work is done on dried material and important characters such as habit and mode of growth are often impossible to detect in dried specimens.

This much can be said: as far as they are known at present, the gametophytes fall into five distinct types associated with the various types of sporophyte in the following manner:

GAMETOPHYTE	SPOROPHYTE
Type A. Dorsiventral	Group I.
Type B. Ramified	Group II (and III?).
Type C. Lobed and green	Group IV and VII.
Type D. Conical and rimmed	Group V.
Type E. Highly differentiated tissues	Group VI.

Groups IV and VII have a distinct affinity. Besides similar gametophytes, both also have the sporophylls fused into a cylindrical tube in at least some of their species. Groups III seems to be nothing but species of group II that have adapted themselves to the terrestrial habit by becoming erect and rigid. Species with type C gametophyte (lobed and green) show the greatest diversity of the types of sporophytes: from weakly differentiated sporophylls to fused sporophylls or a distinct strobile born laterally or on a pseudo-peduncle; from leaves all similar, dispersed around the stem, to leaves in one plane and in dissimilar rows; from an aerial vegetative shoot to pseudo-bulbs or an underground system; from definite growth to indefinite growth and innovations. In contrast to species of type C, the types of sporophytes are decidedly similar in habit, appearance, and mode of growth in the species within each of the other types.

The gametophytes of only a fraction of the species of *Lycopodium* have been studied. How would the present subdivisions stand if gametophytes of most or all species were known? We do not know.

Even though genera are undoubtedly artificial units, they should offer two characteristics: (a) from a theoretical point of view, genera should be groups of closely related species, and should be differentiated from each other by basic structural differences; (b) from a practical point of view, genera should be easily recognizable groups, in such a way that once a number of species of a group are known, most other species will at once be recognized as members of the same genus, although the species themselves may be unknown.

Lycopodium, as it stands at present, lacks the first characteristic, but possesses the second to a superlative degree. If *Lycopodium* L. were split into four to seven groups, the resulting genera would probably show the first characteristic, but would they also have the second and more practical one? To this question, I cannot at present answer yes or no.

A key to the major divisions of *Lycopodium* L., if based on characters drawn from the sporophyte only, would be made up of subdivisions such as the following:

A. Sporophylls sessile or petiolulate, not peltate; branching isodichotomous.
- B. Epiphytes .... Group II.
- BB. Terrestrials .... Groups I, III.

or

- B. New stems arising from the base of the old ones or lacking .... Groups II, III.
- BB. New individuals resulting from the separation of successive branches due to the disintegration of the older parts of each plant, or new individuals sometimes arising from bulblets .... Group I.

AA. Sporophylls slightly prolonged downwards at the base of the blade, thus peltate and stipitate; branching heterodichotomous.
- C. No elongate monopodial vegetative shoot living a few years, all parts of the plant disintegrating within a year; innovations absent .... Group IV.
- CC. Elongate, monopodial vegetative shoot present and usually functioning as a rhizome, all parts of the plant remaining functional for a few years; innovations present .... Groups V, VI.

or

- C. Strobiles borne laterally on short branches .... Group VII.
- CC. Strobiles borne at the end of erect axes or of normally developed branches. Pseudopeduncle often present. Groups V, VI.

or

- C. Leaves free of the stem and branches, usually 6- or 8-farious .... Group V.
- CC. Leaves partly adnate to the branches, usually 4-farious. Group VI.

Because of the similarity of the problems involved, the development of the nomenclature of *Lycopodium* parallels the mosses. As pointed out by W. C. Steere,[4] the Linnean *Hypnum* and *Bryum* were essentially form-genera. This was also true of *Lycopodium* in the Linnean sense and is still quite possibly true even in the modern sense. The natural classification of the mosses began to take shape when Hedwig started stressing the importance of the reproductive structures, mainly the peristoma. Similarly, we now consider *Tmesipteris, Psilotum, Lycopodium,* and *Selaginella* as widely separated genera on the basis of the characters of their spores and sporangia, but we are unable to make full use of the characters of all the reproductive structures because the prothallia of only a minority of the species are known and because the sporophyte is almost never associated with the gametophyte, thus rendering impractical any classification based on the gametophyte.

There is, in the present state of our knowledge, a good possibility that groups based on the characters of the prothallia might be natural groups and that it might be possible to define those groups in terms of the characters of the sporophyte. This possibility, if confirmed, would naturally lead to the splitting of *Lycopodium* in its current sense and the setting up of 4 to 7 segregate genera. However, such a step should not be taken until the gametophytes have become known for at least a majority of the species of each group concerned. Not enough is known yet of these gametophytes to justify such generic segregation, while, on the other hand, the groups listed above are based on minor vegetative characters that do not suffice in themselves for the splitting of the genus *Lycopodium* L.

DEPARTMENT OF AGRICULTURE, OTTAWA, CANADA.

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Reminiscences of the Alaskan Highway

DONOVAN S. CORRELL

Although northern British Columbia and southern Yukon have fewer ferns and fern allies than are to be found farther south, the superb surroundings in which they occur are scarcely surpassed anywhere in North America. It was across this wilderness, from Dawson Creek to Fort St. John, thence to Fort Nelson in British Columbia, northward to Watson Lake and west to Whitehorse in Yukon that the southern half of the Alaska Military Highway was laid for more than 900 miles during the summer of 1942 and winter of 1942–43. The "Road" or "Alcan Highway," as it is popularly called, traverses some of the most rugged territory on the Continent. Great expanses of the Road are in country which, except for a few Indians and trappers, is virtually uninhabited and, to a large extent, is unexplored and incompletely charted. The overcoming of formidable mountain regions, including the Rockies, broad turbulent rivers, deep extensive muskegs, inclement weather, insect pests, and other natural barriers makes this project one of the most difficult human and engineering accomplishments of the century.

The Road, south of Whitehorse, does not go above timberline, although the higher mountains through which the Road travels have their summits well above the tree zone. Most of the country is heavily forested, but the tree species are very few. The forests consist primarily of various combinations of white spruce (*Picea glauca*), black spruce (*P. mariana*), lodgepole pine (*Pinus contorta* var. *latifolia*), and trembling aspen (*Populus tremuloides*), with alpine fir (*Abies lasiocarpa*), balsam poplar (*Populus tacamahaca*), paper birch (*Betula papyrifera* vars.) and northern larch (*Larix laricina*) occurring less frequently. Numerous willow species, two species of alder, and a dogwood (*Cornus stolonifera*), commonly called "Kinnikinnik," are the most frequent shrubby species. Except for Indian camps, army and construction camps, and the old settlements of Fort Nelson, Lower Post, Teslin, and Whitehorse, the region above Fort St. John is an unbroken country of forests, muskegs, tundra, and bare mountain peaks, unspoiled by man.

It was upon a crude and unimproved Road that our party started north from Dawson Creek, British Columbia, early in the summer of 1943, about a year after bulldozers had cut a swath through the forest to make a packtrain trail across the country, later to be followed by the present Road. We made our first encampment along the Beatton River at Mile 101 above Fort St. John, in the outer foothill country at an elevation of 3200 feet. This was the first of a series of base camps which our party established in regions considered to be typical of the larger topographic and vegetational areas of the country. The next camp, after that at Beatton River, was near Summit Lake, at Mile 104 west of Fort Nelson, where the Road passes through the main range of the Rocky Mountains. The elevation here is around 4200 feet, the highest point over which the Road passes. The third camp was at Watson Lake, Yukon, near Mile 350 northwest of Fort Nelson, in the broad plain of the upper Liard River. The last camp of any duration was at Mile 56 northwest of Teslin in a mountainous region, at about 2400 feet elevation. It was possible to work out into the country from all these camps, as well as to make trips up and down the Road of 25 or 30 miles, or more. Frequent stops and overnight camps were made all along the Road, but only the above-mentioned camps were of two weeks or more duration.

Our camp on the Beatton River was on an open lodgepole pine-black spruce slope. Pink Mountain, with its snow-covered crest, towered 5000 feet in the west. A small dogwood-willow-bordered stream trickled down the east side of the slope from a muskeg just above camp to provide us with a supply of ice-cold water. No pteridophytes other than meadow horsetail (*Equisetum pratense*) and wood horsetail (*E. sylvaticum*) were seen in the immediate vicinity of camp. These occurred in seepage soil on a grassy slope and thinly forested area with such typical plants as coltsfoot (*Petasites palmata*), Labrador tea (*Ledum groenlandicum*), arctic raspberry (*Rubus acaulis*), and other shrubby plants which formed a dense tangle.

One day while searching about some large rock outcrops on a high bluff near Mile 97 above Fort St. John I found the fragile or brittle fern (*Cystopteris fragilis*) and the northern shield fern (*Dryopteris dilatata*) in deep crevices. Licorice fern (*Polypodium vulgare*) sent its slender rhizomes into humus-filled fissures, and little smooth woodsia (*Woodsia glabella*) grew in shallow soil-filled holes. Farther north in a dense spruce forest I later found large colonies of bristly clubmoss (*Lycopodium annotinum*), while nearby grew two orchids, the exceedingly beautiful and showy-flowered fairy slipper (*Calypso bulbosa*) and the inconspicuous early coral-root (*Corallorhiza trifida*). Timberberry (*Comandra livida*), a little parasitic shrub, grew about the base of spruce trees. On a grassy slope on the edge of the forest were robust plants of leathery grape fern (*Botrychium multifidum* var. *silaifolium*), growing in the shelter of scattered gray willows (*Salix Bebbiana*), while in the muskeg spreading out from the base of the slope were conspicuous spikes of sky-blue flowers of Jacob's ladder (*Polemonium acutifolium*).

On another occasion I went up the Road to near Mile 108 above Fort St. John where an extensive escarpment could be seen rising above the Beatton River valley. The outer rim of the high ledges was somewhat elevated above the main body of the plateau. This height of rock commanded a magnificent view across the valley to the west and, from the many signs, must be a favorite camp site of nomadic Athabaska Indians. The wide valley resembled a giant viridescent carpet as it swept for miles to the steep slopes of the Pink Mountain anticline. In deep narrow crevices of rocks on the top of this prominence grew robust plants of the northern shield fern. I climbed from the rim of the plateau over the face of the cliffs to forested slopes below. Here the fragrant shield fern (*Dryopteris fragrans*), from which Asiatics make a tea, grew abundantly on the dry loose rocks which had split away from the overhanging ledges to tumble beneath the bluff. This fern proved to be one of the most frequently encountered. It was often observed on open rocks of talus slopes associated with green spleenwort (*Asplenium viride*). Large colonies of the fragile fern draped their graceful fronds from the moister crevices of the shaded overhanging ledges, and on the face of the cliff in shallow fissures rusty woodsia (*Woodsia ilvensis*) and a few plants of the common licorice fern were found in hidden niches.

Because of heavy rains which had washed out numerous bridges to the north we were temporarily marooned at Beatton River. During this time I made a day's trip to the gorge of the Sikanni Chief River at Mile 115 above Fort St. John. The willow thickets on the floor of the gorge through which the river ran supported large colonies of field horsetail (*Equisetum arvense*), water horsetail (*E. fluviatile*), and mottled scouring-rush (*E. variegatum*), as well as gigantic plants of the northern bog orchid (*Habenaria hyperborea*). In the sandy gravel bars of a nearby open stand of aspens were vast mats of mountain avens (*Dryas Drummondii*), with their solitary bright yellow flowers nodding from slender pedicels, a delicately flowered blue-eyed grass (*Sisyrinchium* sp.), a lupine with flaming red-lavender flower-spikes, pasture wormwood (*Artemisia frigida*), purple loment (*Hedysarum Mackenzii*), with its showy reddish purple flower-spikes, while on grassy slopes just above the floor of the gorge were clumps of roses, with their solitary bright pink flowers standing out among the other shrubs. Still farther up the slope on rock ledges in spruce forests grew large mats of saxifrage (*Saxifraga tricuspidata*), its creamy white flowers producing a bright display against the reddish leaves, and just at the edge of the forest were large clumps of creeping juniper (*Juniperus horizontalis*).

The trip northward from Beatton River to Fort Nelson was along the great watershed of the Minaker River which led into the Prophet River which, in turn, emptied into the Muskwa River near Fort Nelson. Views of the surrounding country were magnificent from the Road. The journey, however, was almost fernless as well as uneventful except for a brief encounter with a persistent black bear who annoyed us at lunch one day by trying to snatch sandwiches out of our hands. The northern shield fern was often seen covering slopes on the edge of forests and, except for clubmosses, was the only fern seen until isolated clumps of ostrich fern (*Pteretis nodulosa*) were observed on the mud flats of the Muskwa River at Fort Nelson.

From Fort Nelson we traversed part of the broad forested watershed of the Fort Nelson River and then, following the Tetsa River Valley, we climbed the Rockies to the beautifully scenic region of Summit Lake.

About a mile above the head of Summit Lake (near Mile 104 above Fort Nelson) we made camp on the shore of a small lake in a glaciated valley. The lake nestled at the base of an old glacial moraine. This valley was actually a narrow pass through the main range of the Rocky Mountains and, although before glaciation it apparently was a broad sweeping plain, it was now for the most part filled with enormous moraines. Towering mountains arose in the surrounding country, with their upper barren faces scalloped by cirques to resemble a series of huge amphitheaters. The Road here reached its highest point, and the botanizing proved to be the most interesting and productive of any on the entire trip.

The spruce forest which covered the lower half of the moraine slopes above camp supported in its thick carpet of lichens and mosses, overlying seepage soils and rich humus, many plants typical of the alpine country, including crowberry (*Empetrum nigrum*), small cranberry (*Vaccinium oxycoccos*), mountain cranberry (*V. Vitis-Idaea* var. *minus*), cassandra (*Chamaedaphne calyculata*), bog rosemary (*Andromeda polifolia*), bearberry (*Arctostaphyllos Uva-ursi*), white heath (*Cassiope tetragona*), red false heather (*Phyllodoce empetriformis*), and small northern bog orchid (*Habenaria obtusata*). Mats of mountain azalea (*Loiseleuria procumbens*) grew in the thin bare soil on the lower slopes. Dwarf birch (*Betula glandulosa*) and a shrubby floriferous cinquefoil (*Potentilla fruticosa*) grew everywhere, filling in the spaces not occupied by other shrubs. In wet soil on the lake shore were to be found isolated plants of blue-flowered butterworts (*Pinguicula vulgaris*) and false asphodel (*Tofieldia intermedia*), and in a small meadow across the lake were deep blue-flowered plants of larkspur (*Delphinium* spp.), monkshood (*Aconitum* spp.), and clumps of little marsh felworts (*Lomatogonium rotatum*).

The alpine timberline, being only several hundred feet above camp, could easily be reached by a short climb where tundra-covered slopes provided a veritable garden of alpine flowers. Many hours were spent here separating out the many species of mosses which grew entwined among the low shrubs and rocks. Long restful views could be had of the rolling mountain ranges and of the ever-active Road.

In order to reach the high mountain arising just northeast of camp it was necessary to make a hot dusty climb up a drag trail on the south slope down which horses dragged firewood for a construction camp nearby. The trail led through a burnt-over forest and eventually brought us out onto an alpine meadow or tundra filled with sedges and bluegrasses (*Poa* spp.). The soil was soggy and cold, and a chill filled the air in marked contrast to the intense heat and aridity of the dusty slope. Blue arctic lupines (*Lupinus arcticus*), several species of *Carex*, various buttercups (*Ranunculus* spp.), creamy white-flowered northern anemone (*Anemone parviflora*), and yarrow (*Achillea borealis*) grew scattered over the meadowland.

From the meadow we followed a great dry gulch filled with sharp-angled debris right to the top. On the way up near the summit we passed over the remnant of a snowfield. A perpetual draft flowed up the trough and brought on its current small brown butterflies which struggled helplessly among the stones. Tiny crucifers, especially species of *Draba* and *Arabis*, grew among the broken rocks, and the strongly purple-veined, inflated calyx of the nodding flowers of *Lychnis apetala* brightened the loose gray shale. We came up onto a small sheltered saucer-shaped plateau just below the narrow strip of tablerock which comprised the tip-top. Scattered over this flat were innumerable plants of golden-flowered poppies (*Papaver radicatum*), crucifers, and miniature deep blue bell-flowers (*Campanula* sp.). Arriving at the top, we had a complete panoramic view. A steady cyclonic wind swept up the northwestern slope and came across the top with extraordinary violence. Large patches of *Selaginella selaginoides* covered the shallow soil. From where we stood we could look almost straight down into the valley to the east. Enormous alluvial fans and anastomosing streams unfolded over the entire landscape—the view from this mountain was well worth the strenuous climb.

McDonald Creek, a much too modest name for this wild uncontrollable river, drains a tremendous mountain range west of Summit Lake (*Pl. 5*) and flows northward from its juncture with the Road at Mile 106 above Fort Nelson. The meadow on the east side of the creek consisted of a thin layer of sandy muck overlying a base of coarse gravel and stone, the result of flooding. Colonies of the yellow lady's slipper (*Cypripedium calceolus* var. *pubescens*) grew among the thin covering of grasses and sedges, a rather unusual habitat for this plant, while scattered about were tiny plants of deep blue-flowered *Campanula uniflora,* a bell-flower without a bell-shaped corolla, and minute almost hidden plants of *Selaginella selaginoides* lay prostrate on bare wet soil and revealed themselves only by their short erect stubby spikes. As I crossed the meandering river bed along sand-gravel bars, broken ledges, and emergent rocks and boulders, I could see distant patches of the broad-leaved fireweed (*Epilobium latifolium*), forming deep lavender-pink blotches above the water. Bristly dwarf scouring-rush (*Equisetum scirpoides*) made a veritable lawn in the shallow mud flats bordering the edge of the water, and the repent American twinflower (*Linnaea borealis* var. *americana*) draped its runners from the rocky bank of a nearby woodland. On gravel-sand bars grew extensive colonies of creamy white-flowered dryads (*Dryas octopetala* and *D. integrifolia*), interspersed with plants of

Indian vetch (*Astragalus aboriginum*), green sagebrush (*Artemisia discolor*), purple-flowered fleabane (*Erigeron* sp.), and the arctic *Rhododendron lapponicum*. Upon searching the dense spruce forest, several orchids, including northern twayblade (*Listera borealis*), heart-leaved twayblade (*L. cordata*), and small round-leaved orchis (*Orchis rotundifolia*), were found to grow scattered in the thick covering of mosses and lichens among colonies of one-flowered shin-leaf (*Moneses uniflora*), two other species of shin-leaf (*Pyrola asarifolia* and *P. secunda*), and ground-pine (*Lycopodium obscurum* var. *dendroideum*). In the boggier situations rosy-flowered *Pyrola uliginosa*, swamp gooseberry (*Ribes lacustre*), and arctic raspberry (*Rubus arcticus*) grew here and there.

From Summit Lake, the Road follows the valleys and canyons of several rapidly flowing, fish-filled rivers with such interesting names as Racing River, Toad River, and Trout River. At the head of the latter river is Lake Muncho, one of the most impressive regions along the Road. The Lake is surrounded by towering mountains and resembles a fjord. It is clear and deep, full of fish, and most invigorating. The Road follows several miles around the edge of the lake where it was chiseled and blasted out of the almost vertical rock walls at the reputed cost of one million dollars a mile. There are enormous outwashes, composed of broken limestone rocks which fan out from great gulches cut into the mountains. In heavy rains these alluvial fans become torrential stream beds. We camped on one of these fans which supported isolated groves of willows, spruce and aspen. The arctic laurel (*Kalmia polifolia*) grew sparsely in isolated clumps while numerous herbaceous plants, including the rare sparrow's egg orchid (*Cypripedium passerinum*), grew on the less permanent terrain.

Although we made camp at Watson Lake, Yukon, after leaving Summit Lake it will not be considered here since no additional ferns were noted there. The region, especially the saline meadows south of Watson Lake, were of special interest. Also the journey from Watson Lake to Whitehorse was not productive of ferns. Upon our return from Whitehorse, however, we made camp at Mile 56 west of the old village of Teslin and found that botanizing was especially interesting in the mountains of this region.

From the opening of my tent a large ashy gray mountain could be seen looming above the spire-topped black spruce and dome-shaped lodgepole pines (*Plate 5*). When I started out from camp that morning it was my desire to explore the tablelands on the summit of this mountain. Its sheer precipitous wall reared boldly into the sky, bleak and exposed, and the talus which had crumbled from its broken face spread like a ponderous marble blanket to engulf and bury the upper reaches of the valley forest. Splintered and shattered trunks of forest giants remained as monuments to this sluggish force of destruction. Dainty herbaceous plants, particularly of the mustard and sunflower families, had dropped their tiny seeds onto this barren mass and they had germinated sufficiently on a thin film of moist limy soil to send their slender roots into subterranean nutritive reservoirs to maintain and establish themselves. Mountain willows and golden-flowered cinquefoils (*Potentilla* spp.) clung tenaciously to the unstable slope, and multicolored louseworts (*Pedicularis* spp.) and the ubiquitous lavender-flowered lungwort (*Mertensia paniculata*) nodded as the peaked bladdery capsules of locoweeds (*Oxytropis* spp.) and milk vetches (*Astragalus* spp.) rattled in the fitful breeze. Black-headed fleabanes (*Erigeron melanocephalus*) grew in isolated patches at

Above: McDonald Creek, near Summit Lake, British Columbia
Below: Camp at Mile 56, northwest of Teslin, Yukon

the base of ledges in freshly fallen rubble. The sharp angular limestone debris gnawed into the leather around my hobnails with every upward step.

After ascending to above timberline to the base of the bluffs and making several unsuccessful attempts to scale the high walls, I eventually was able to climb over some grass-covered ledges and soon located a narrow pass which led over the precipitous bluffs into a deep hidden valley beyond. Goat and bighorn trails led in all directions over the lush tundra. Here and there showy spikes of creamy white flowers of poison camas (*Zigadenus elegans*) dotted the meadowland, and on a grassy bank along a small stream wild strawberries (*Fragaria glauca*) grew luxuriantly. On the rim of a limestone sink were numerous plants of moonwort (*Botrychium Lunaria*), and just above the sink on a rocky slope grew stunted trees of alpine fir. I continued on up the steep slope of the canyon-like valley to the very summit of the range where a vast tableland unfolded before me. Dotted over this treeless mountain plain were depressions of varying degrees of size and depth. Forming large mats in many of the sinks were inconspicuous tufted clubmoss (*Lycopodium sitchense*), fir clubmoss (*L. Selago*), and alpine clubmoss (*L. alpinum*). In others grew large colonies of showy purple-top mountain timothy (*Phleum alpinum*) intermingled with other grasses and sedges. Here and there dwarf willows threw their warped shadows over patches of bare lichen-spotted soil, and the bright blue flowers of alpine forget-me-nots (*Myosotis alpestris*) formed brilliant clumps above the grasses.

The view from the rim of this high plateau was the most impressive I experienced all summer. This was doubtless because of the wild loneliness of the country which was sealed off by the bluffs I had climbed from all signs of civilization brought in by the Road. Miles away, at the base of a long descent, a slender silvery lake cut a narrow swath in the dark spruce forest and dwindled from sight beyond a nearby insuperable ledge. The sun beat down mercilessly from between storm clouds, but a cool breeze swept up from the lake below bringing with it the odor of soft mud kneaded by the feet of moose, bear, and caribou. Westward rolled seemingly without end crest on crest of the Alaskan Range with enormous gleaming glaciers sprawled from their high crevasses and cirques. The intense silence was almost oppressive, broken only now and then by the fleeting plaintive notes of russet-colored alpine finches as they were helplessly blown along the rocky rim by the persistent upswept current of valley air. I could have lain there for an hour or for eternity. It would have all been the same.

The loud thump, thump of what must have been the warning kicks of a nearby snowshoe rabbit vibrated the ground and awakened me from my day dreaming. All was silence once again. Only the noiseless rapid movement of several white dots across the broken face of a distant cliff disturbed the peaceful scene—goats were gamboling on the precarious ledges. I stretched, arose, and ambled off to the right.

The ancient game trail, cut deeply into the limestone strata, led around the base of a large bluff and came out onto a small grass-covered plateau which overlooked the valley. The soil and turf were churned by innumerable tracks of sheep and goats, with here and there in muddy seepage the ominous impressions of the feet of carnivores. Beneath sheltered rock ledges, from which grew delicate fronds of parsley fern (*Cryptogramma crispa* var. *acrostichoides*), were growing in wet exposed soil tiny alpine saxifrage (*Saxifraga nivalis*) and reddish plants of mountain sorrel (*Oxyria digyna*), their liver-shaped leaves spread to form a brilliant rosette at the base of the short slender flowering stem. Extending out into the surrounding tundra were large colonies of coltsfoot (*Petasites frigida*), and onto the drier sites scorpion-weed (*Phacelia sericea*), with its elongated spikes of blue flowers. At the far edge of the plateau gnarled and twisted skeletons of relic alpine willows were draped with long flowing strands of ochreous lichens. As gusts of updrafted air blew through this lifeless grove the drooping strands of lichens became animated golden tresses as they lightly whisked the lengthening rays of the late afternoon sun. The distant mottled dull and light gray limestone slopes reflected intricate patterns where the somber spruce forest stretched tenuous green digits into sheltered ravines above timberline. The steep meadow directly below me was drowned in the shadow of the massive bluff, and the slender lake below reflected shapeless twilight shadows from the deep forest along its shores as I made my way down the slope in the direction of camp.

On the trip south we stopped to see Senlac Falls at Mile 88 below Teslin. The falls cascaded over and between gigantic boulders. Among the rocks above the falls grew large colonies of burnet (*Sanguisorba* sp.) together with some peculiar sedges, and in a nearby cold bog were plants of the long-beaked *Elephantella groenlandica,* and marsh horsetail (*Equisetum palustre* var. *americanum*).

Upon leaving the Road to visit the hot springs in Tropical Valley at Mile 213 above Fort Nelson I entered a rich forest which had decidedly the aspect of a hardwood forest of the eastern States. The tree species here were more numerous than usual and robust; the undergrowth more rank and luxuriant. Breaking through this dense strip of forestland, I came out upon an extensive salt flat which was sparsely covered with tamarack. At my feet, growing in the shallow saline water, the uncommon lobelia (*Lobelia Dortmanna*) reflected its delicate light blue flowers on the glassy surface. Sedges and grasses grew everywhere in scattered clumps and hummocks which, in turn, supported a thick, shrubby vegetation and a few herbs, among which was a ladies tresses (*Spiranthes Romanzoffiana*). Walking across the flat in the direction of the fabulous hot springs which gushed from the mountainside, I entered another even more dense forest, on the border of which were deep quiet pools in which grew great colonies of sphagnum moss. Tall aquatic plants, including water hemlock (*Cicuta occidentalis*), thrust themselves up through the dense blanket of moss and stood free to sway in the breezes. As in the first forest, the size of the trees and density of the undergrowth was strikingly similar to an eastern woodland. Choke cherry (*Prunus demissa*), red baneberry (*Actaea rubra*), kinnikinnik (*Cornus stolonifera*), snowberry (*Symphoricarpus albus* var. *pauciflorus*), and various *Ribes* were among the many species forming the understory of the forest. Masses of luscious red raspberries (*Rubus strigosus*) entwined themselves in the fronds of the northern shield fern, and growing trailing in colonies beneath the trees were numerous plants of northern oak fern (*Phegopteris Robertiana*). Sweeping the base of the mountain in seepage soil was a striking stand of ostrich fern (*Pteretis nodulosa*). The plants were the largest I had ever seen. They towered well over my head and grew so thickly in the fertile black soil that it if were not for the ancient animal trails to follow I would have given up in despair trying to reach the foot of the mountain. Literally acres of these graceful fronds stood like sentinels guarding the reaches of the mountain beyond.

Eventually arriving at the base of the forest-clad mountain, I climbed to near its summit and then began the descent of the slope directly above the hot springs. Large vines of honeysuckle (*Lonicera glaucescens*) climbed on shrubs in open-wooded areas in the spruce-fir forest, and long slender rhizomes of running clubmoss (*Lycopodium* *clavatum*) and ground-pine (*L. complanatum*) threaded the mossy floor. Several crystal-clear streams cascaded through the open forestland and disappeared over the rampart to the slopes below. The banks and waters of these streams were verdant with numerous familiar and unfamiliar plants. The porous rocks and mineral-encrusted algae and vegetable debris lying in the stream beds were riddled with larvae, of what species I do not know. Descending the gently sloping plateau on which I found myself, I came out rather abruptly onto its crown. Spread before me were numerous water-sculptured terraces of all sizes, shapes, and color. Each terrace formed a pool of varicolored lukewarm water, which flowed gently over the knife-edged rims. Large lacy plants of the Virginia rattlesnake fern (*Botrychium virginianum* var. *europaeum*) and towering specimens of the northern rein-orchid (*Habenaria hyperborea*) grew in moist pockets among the porous rocks. Just below these terraced pools was a large deep pond of almost too hot water, while nearby another pool was fed by two large springs—one exceedingly hot, the other cold—which converged just above the pool to give water which was just the right temperature for bathing.

Near Mile 55 above Fort Nelson we stopped briefly in a spruce-balsam-birch forest region in a high range of mountains. Red raspberries (*Rubus strigosus*) grew profusely along the Road banks, while oak fern (*Phegopteris Dryopteris*) and clubmosses trailed in humus of the dense forest and several tiny plants of lance-leaved grape fern (*Botrychium lanceolatum*) grew rigidly through the mosses.

Our last stop of more than a day was on the Buckinghorse River at Mile 131 above Fort St. John. The morning before we left ice was formed by spray on the log we used for crossing a small stream. Obviously the season for collecting plants was almost at an end. Our last camp on the Blueberry River proved definitely that the summer was at an end. We made camp in a small woodland on the edge of a muskeg. That night as we lay in our sleeping bags we could hear the twilight songs of coyotes. Beginning with a series of short barks and increasing in power and pitch they would end in a long quavering wail. The whining howl of these hunting prairie wolves cut through the chill air to make me cuddle deeper into my bag. The temperature dropped to 18° F. during the night, and the next day (September 5) herbaceous vegetation lay drooping about us.

ACKNOWLEDGMENTS

The above observations were made while on a botanical-geological survey party on the southern half of the Alaska Military Highway during the summer of 1943. Our party was sponsored by the Joint Economic Committee, Canada–United States, the Arnold Arboretum of Harvard University, the Geological Society of America, and the National Museum of Canada.

Grants and assistance from various institutions and foundations financed and equipped the expedition, transportation on the Road was supplied entirely by the Northwest Service Command of the United States Army, and subsistence supplies were purchased from the Army commissaries.

The expedition was under the direction of Dr. Hugh M. Raup, now Director of the Harvard Forest. At the request of Dr. E. D. Merrill, then Director of the Arnold Arboretum, I joined the party as Dr. Raup's botanical assistant. Other members of the group were Dr. Raup's wife, Lucy C. Raup, and their two sons Karl and David, and Dr. Charles S. Denny, now with the U. S. Geological Survey.

UNITED STATES DEPARTMENT OF AGRICULTURE, *Washington, D. C.*

The Geographical Distribution of Negripteris scioana

RODOLFO E. PICHI-SERMOLLI

In 1946 I described[1] a new genus of Filicales, *Negripteris*, typified by *N. scioana* (Chiov.) Pichi-Sermolli[2], the only known species. The original description was based on the only specimen known to me at the time (*Negri* 1186). In 1948 while working at the herbaria of the British Museum, Kew, Paris, and Geneva on a monograph of the ferns of northeastern tropical Africa, I found other specimens of *Negripteris scioana*. Additional specimens were found among ferns which I borrowed for study from the herbaria in Vienna, Leiden, and Stockholm.

Negripteris scioana is now known to have been collected in several localities in northeastern tropical Africa and Arabia. The range is included in the "Nordostafrikanische Hochland-und Steppenprovinz" of Engler.[3] Later, Engler[4] enlarged this "Provinz" and made it include the "ostäquatorialen Hochländer," but I prefer to follow the earlier division of the tropical African vegetation. Within this part of northeastern tropical Africa and Arabia *Negripteris* is present only in the mountains on the margin of the sides of the Abyssinian and Arabian plateaus which face the Red Sea[5] and the Gulf of Aden

[1] Pichi-Sermolli, R. E. Negripteridaceae e Negripteris, Nuova Famiglia e Nuovo Genere delle Filicales. Nuov. Giorn. Bot. Ital. 53: 129–169. *pl. XIV–XVI, 4 fig.* 1946. The number of this journal was published in May 24, 1947, but separates of my papers were issued in advance and distributed at the end of November, 1946.

[2] Based on *Mohria scioana* Chiov.

[3] Engler, A. Die Pflanzenwelt Afrikas insbesondere seiner tropischen Gebiete. In Engler and Drude, Veget. der Erde 9, vol. 1^1. 1910.

[4] *Op cit.* vol. 5^1. 1925.

[5] The only specimen from the western side of the Abyssinian Plateau is Schimper's specimen cited below.

respectively, in the mountains of northern Somaliland, and in Socotra. It does not, as a rule, appear far inland in Abyssinia, Arabia, or Somaliland, the only locality far from the coast being in fact Sodarè, in the Middle Valley of Hawasch, where the Abyssinian Plateau is cut by the Great Rift Valley.

Negripteris grows on soils derived from Pre-Cambrian schists, granites, and gneisses, from Jurassic limestone, from limestones of the Lower and Middle Eocene, and from the more recent eruptive rocks.[6]

The climate of the localities in which *Negripteris* occurs is varied and hard to determine; however, we may say, as a suggestive indication, that in these localities the mean annual temperature ranges from 24° to 28° C., and the rainfall varies from 300 mm. to 600 mm. per annum.[7]

Negripteris is found in the crevices of rocks and on stony soils in dry places at altitudes between 500 and 2000 meters. It may be expected to occur in plant formations of different kinds. Briefly, according to Collenette,[8] Negri,[9] and Gillet,[10] we may say that it grows in the open deciduous scrub, in the open *Acacia*-woods, and in transitional formations between these and the evergreen scrub.

The examination of the specimens cited below enables me to form an idea as to the variability of *Negripteris*. In most of the specimens the fronds agree completely with the type specimen of the species, but some plants have fronds slightly different in shape, covering, or thickness.

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[6] Cfr. Dainelli, G. Geologia dell' Africa Orientale. Reale Accad. d' Italia, Centro Studi A.O.I. 7, vol. I–III. Roma, 1943.

[7] Cfr. Fantoli, A. Elementi Preliminari del Clima dell' Etiopia. Centro di Studi Coloniali. Firenze, 1940.

[8] Collenette, C. L. North-Eastern British Somaliland. Kew Bull. **1931**: 401–414. *pl. VIII, IX*. 1931.

[9] Negri, G. Per uno Schema Cartografico della vegetazione dell' Africa Orientale Italiana. Riv. Geogr. Ital. **47**: 2–16. 1940.

[10] Gillet, J. B. The Plant Formations of Western British Somaliland and the Harar Province of Abyssinia. Kew Bull. **1941**: 37–199. *pl. I–III*. 1941.

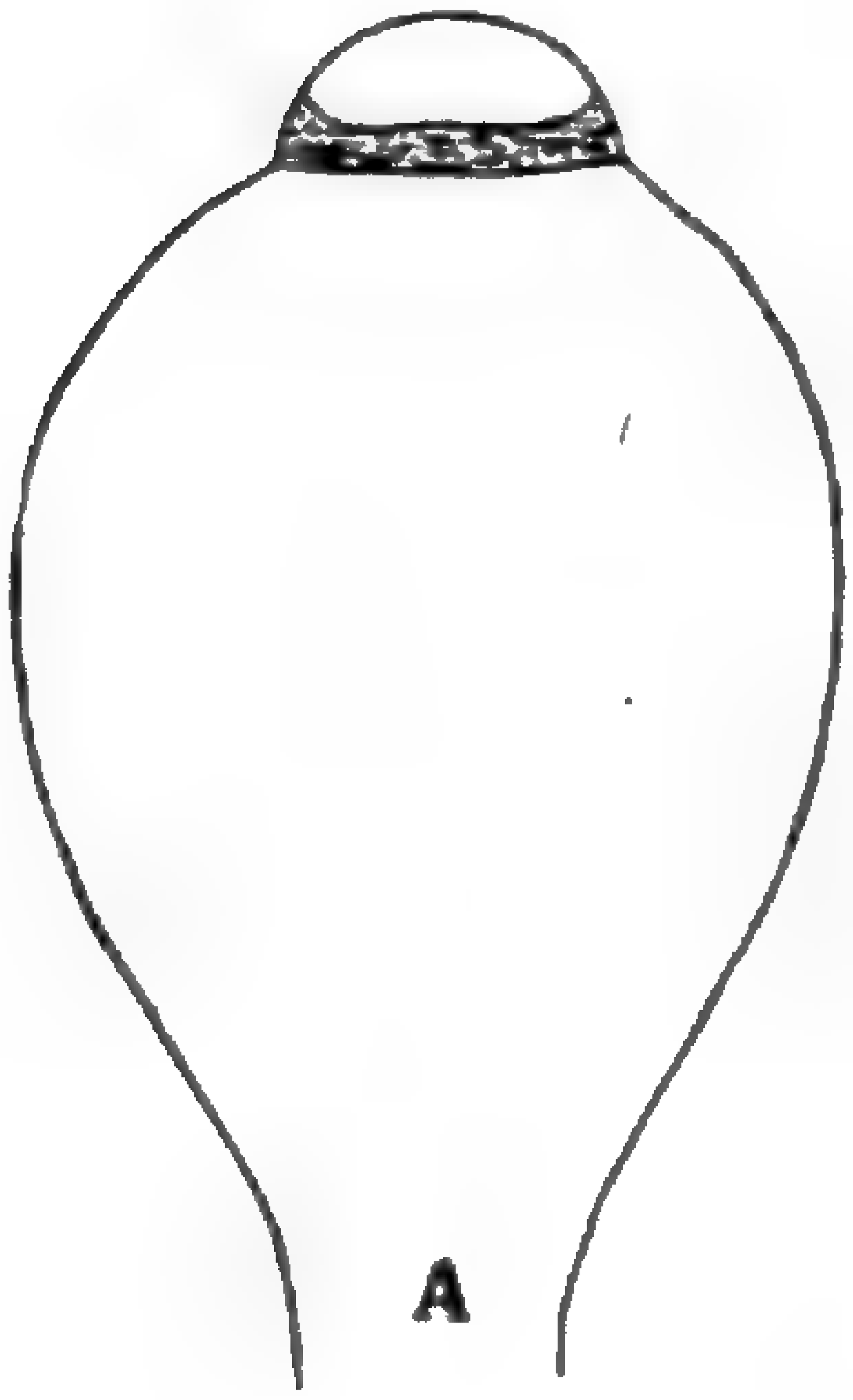
Hildebrandt's no. 1488, collected "an schattigen Orten," and Deflers' nos. 600 and 628 have the fronds wider and thinner. Schweinfurth and Riva's no. 441 has shorter fronds, poorly covered with the white powder beneath. Bent's no. 75 and Vesey-Fitzgerald's no. 12810 have the fronds much shorter than in the type specimen and pentagonal in outline, with the pinnae 2-or 3-jugate. If we had to deal only with the last-named specimens and with the type we should be led to establish a variety, but Lunt's no. 133, although of small size, and Balfour's no. 329 have fronds intermediate between the extremes; moreover, Vesey-Fitzgerald's specimen has a sterile frond which, although very small, in its outline resembles the type specimen. Probably seasonal conditions are responsible for the shape of the frond in Bent's and Vesey-Fitzgerald's specimens. They were, in fact, collected out of season, when the fronds, as Vesey-Fitzgerald writes on the label of his specimen, "are all dried and brittle."

The number of sporangia in a sorus is not always 1 or 2 (rarely 3) as in the type specimen. In Balfour's and in Collenette's specimens I have counted in fact 4 or 5 sporangia in each sorus. In these specimens we have a sorus of radiate-uniseriate type, the sporangia being arranged rosette-fashion around a central receptacle. The center of the sorus, sometimes vacant, is more frequently occupied by one sporangium. This conformation of the sorus is due to the subsessile sporangia of *Negripteris.*

On the subject of oligosporangiate sori and short-stalked sporangia I wish to clear up an inexactness. Weatherby[11] in his comment on my paper states that these characteristics were overlooked in my study of *Negripteris.* On the contrary I extensively and clearly discussed them[12] and compared *Negripteris* with other ferns,

[11] Weatherby, C. A. A Proposed New Genus and Family of Ferns. Amer. Fern Journ. 38: 58–61. 1948.

[12] Cfr. pp. 139–142 of my 1946 paper.



A

B

FIG. 1.

A

B

FIG. 2.

Fig. 1. Diagram showing the vertical section of the sporangium cut orthogonally to the annulus. A) *Aleuritopteris farinosa* (Forsk.) Fée. B) *Negripteris scioana* (Chiov.) Pic. Ser.

Fig. 2. Diagram illustrating the sporangium in a vertical section which cuts the annulus lengthways. A) *Aleuritopteris farinosa* (Forsk.) Fée. B) *Negripteris scioana* (Chiov.) Pic. Ser.

such as the old genus "*Notholaena*" and other Cheilantheae, in which oligosporangiate sori and short-stalked sporangia are frequent.

In the specimens I have examined, the sporangium keeps constant in its characteristics; therefore, I can add little or nothing to what I wrote in my paper of 1946. However, I wish to dwell briefly on the structure of the sporangium, because it affords the best characteristics by which to distinguish *Negripteris* from other ferns. In most genera of the old "Polypodiaceae," the annulus is superelevated with respect to the lateral walls, and it occupies breadthwise only a small part of the surface of the sporangium (*pl 6, fig. 1A*). Sometimes, as I indicated in my previous paper, the annulus is broad and composed of cells elongated breadthwise (in such genera as *Ceratopteris* and *Sinopteris*, and in some species of *Aleuritopteris* and "*Notholaena*"), but then the annulus is always superelevated and occupies barely a fifth of the circumference in a longitudinal section that cuts the sporangium orthogonally to the length of the annulus. On the contrary, in *Negripteris* the annulus is not superelevated (i.e. it lies on the same surface as the lateral walls of the sporangium), and occupies a third of the circumference of the sporangium (*pl. 6, fig. 1B;* cfr. also *pl. XV and XVI* of my 1946 paper).

Another characteristic which distinguishes *Negripteris* from other genera is the structure of the cells of the annulus. In the majority of Filicales, the cells consist of strongly indurated radial and proximal tangential walls and of thin distal tangential walls, these not indurated at all (*pl 6, fig. 2A*). In these ferns, the sporangium is provided with a stomium. On the contrary, in *Negripteris* the walls of the cells of the annulus are all strongly indurated, and no stomium is found (*pl. 6, fig. 2B;* cfr. also *pl. XVI* of my 1946 paper).

Owing to this different structure the sporangium in *Negripteris* dehisces in a manner different from other ferns. The dehiscence in the "Polypodiaceae" is well known and I think it needless to describe it, the dehiscence being based on an eversion of the annulus; this eversion is made possible by the structure of the annulus, the distal tangential walls of which are not indurated.[13] In *Negripteris* an eversion of the annulus is impossible because all the walls of the cells are strongly indurated and a stomium is absent. The dehiscence therefore takes place in a different manner, the rupture of the annulus taking place in the third, fourth, or fifth inner cells, or between these and the base of the sporangium. Then the broadest wall of the sporangium breaks transversely in the middle or along the line of union with the annulus. Simultaneously, the annulus bends its free extremity on the side opposite the broken wall, thus entailing also the rupture of the other narrower wall of the sporangium. Dispersion of spores occurs through a small slit by the simple action of gravity. Afterwards, the annulus and the upper part of the sporangium, having detached themselves, fall to the ground and thus assure a complete dispersion of all the remaining spores. In consequence, only the base of the sporangium remains attached to the sorus (cfr. *pl. XVI, fig. 3,* of my 1946 paper).

The distinctive characteristics of *Negripteris,* some of which I have discussed above, amply justify, in my opinion, the recognition of *Negripteris* as a genus. Because of the peculiar structure of its sporangium, *Negripteris* can not be included in any of the recognized genera of ferns. Inasmuch as we are dealing here, in the structure of the sporangium, with a character of fundamental importance in the taxonomy and phylogeny of ferns, I proposed in 1946 the new family Negripteridaceae. It may

[13] *Fig. 17* in volume 1 of Bower's "The Ferns" shows the dehiscence of polypodiaceous ferns clearly.

be that some students will prefer to include *Negripteris* in the Cheilantheae, but such a proceeding, in my opinion, is contrary to the naturalness that any taxonomic group must have, and is contrary also to convenience. After three years of study of ferns since I published my paper on *Negripteris*, and after having examined further specimens belonging to this genus, I must honestly confirm today my proposal of 1946.

Below I list the specimens I have examined of *Negripteris scioana*. The collections have been assigned letters of the alphabet, thus correlating the collections with the accompanying map. The location of specimens in various herbaria is indicated by the abbreviations proposed by J. Lanjouw.[14] The abbreviation of my own herbarium is Pic. Ser.

A. ABISSINIA MERIDIONALE: Scioa, Media valle dell' Hauasch. Colle sassoso sopra le sorgenti termali di Sodarè, 1400 m., 10 Lug., 1909, *G. Negri* 1186, *Typus* (FI, Pic. Ser.).—Sodarè lies southeast of Addis Abeba (lat. 8° 25′ N., long. 39° 25′ E.).

B. SOMALILAND: Darabole (lat. 10° 07′ N., long. 42° 58′ E.), 1868 m., stony ground in turfs, August 1933, *Godding* 111 (K). Vernac.: "Saruck."—This locality corresponds to Mount Darabileh on the maps of Somaliland; it lies northwest of Buramo.

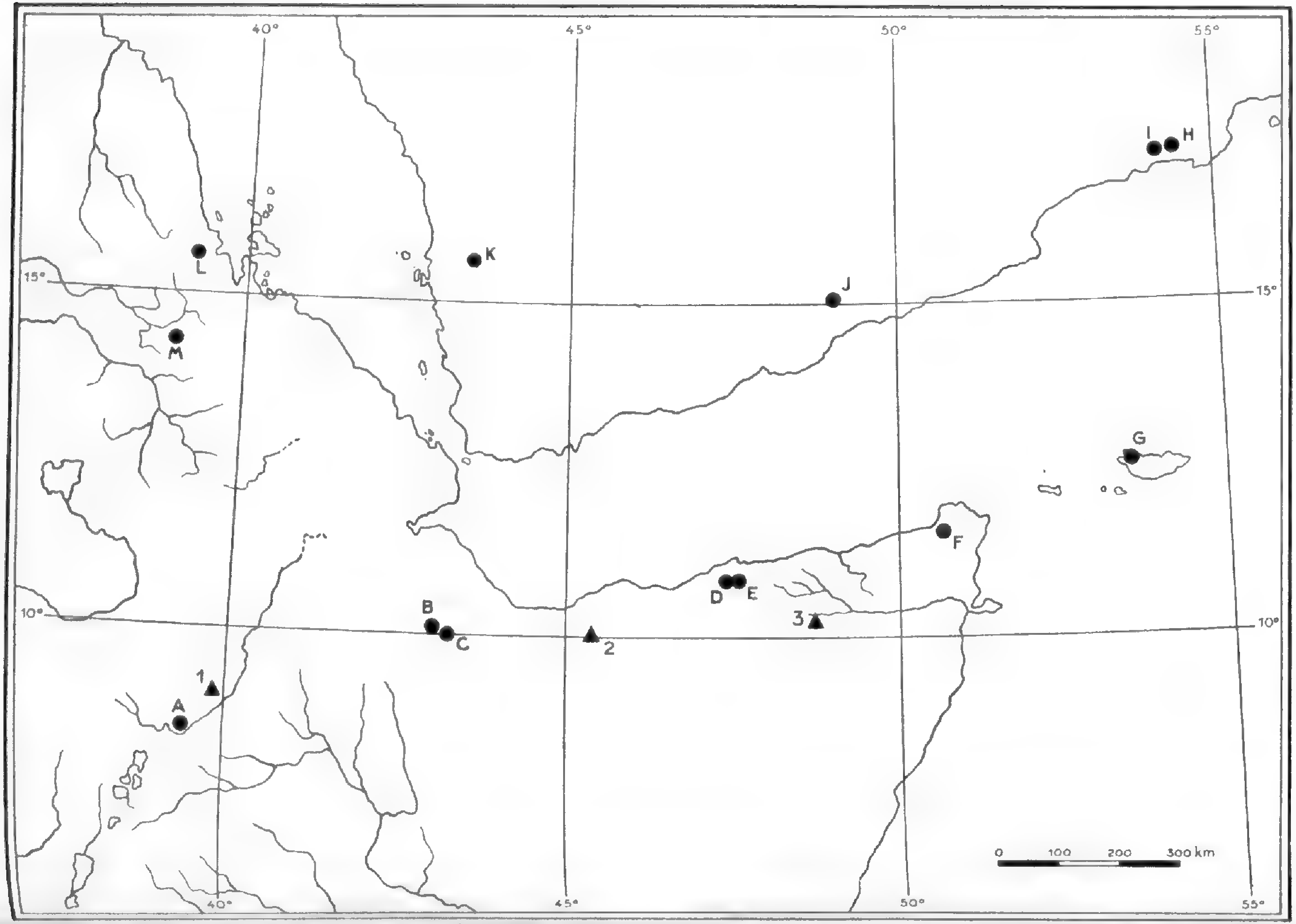
C. SOMALILAND: Mount Rarele, near Buramo (lat. 10° 00′ N., long. 43° 15′ E.), 1800 m., on gneiss mountain top in transition zone from open *Acacia*-wood to evergreen scrub, 29 Dec., 1932, *J. B. Gillet* 4728 (K). "Leaves white beneath."

D. SOMALILAND: Medisheh (lat. 10° 47′ N., long. 47° 35′ E.), 5000 feet, under shelter of rocks on dry slope, common on one hill slope, 16 Sept., 1929, *C. L. Collenette* 5 (K, FI). "Also at Buran; not seen at Hormo, 1 Sept., 1929."

E. SOMALILAND: Meid: Ahlgebirge, 500–1300 m., in Rissen der Kalkfelsen an schattigen Orten, häufig, Apr. 1875, *J. M. Hildebrandt* 1488 (BM, K, L, P, W).—On the map I have marked this locality in the western part of the Ahl Mountains, because I think that this was the part Hildebrandt travelled over in 1875. Kurtz[15]

[14] Chron. Bot. 5: 142–150. 1939.

[15] Kurtz, F. Ueber J. M. Hildebrandt's Reisen in Ostafrika. Verh. Bot. Vereins Brandenb. 19: III–IX. 1877.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says that Hildebrandt in his second journey to Somaliland visited the Serrut Mountains. However, Hildebrandt was certainly in the Ahl Mountains also in 1875; in his collections made in April, 1875, we find many specimens labelled ''Ahlgebirge'' (e.g. no. 1487, *Acniopteris radiata* (König) Link, and no. 1486, *Adiantum Capillus-veneris* L.), as well as specimens labelled ''Serrus-gebirge'' (e.g. no. 1489, *Cheilanthes coriacea* Decne.).

F. MEDJOURTINES: Monts de Meraya, *G. Revoil* 140 (P).—Perhaps this specimen was collected in the mountains southeast of Meraya during the trip to Aren that Revoil[16] took in November, 1880. The specimen was identified and reported by Franchet[17] as *Cheilanthes fragrans* Hook.

G. SOCOTRA: February–March, 1880, *J. B. Balfour* 329 (BM, K, P).—In the above mentioned herbaria this collection is identified as *Cheilanthes farinosa* (Forsk.) Kaulf. No locality is quoted on the label, but according to Balfour's paper[18] this fern was collected ''on the hills southwest of Galonsir.'' Balfour explored this part of Socotra in the second half of February, 1880. Galonsir lies at the northwestern end of the island; in modern times it has been known as Kallansiya.

H. SOUTHERN ARABIA: Dhofar: J. Qara, 1 Nov., 1943, *D. Vesey-Fitzgerald* 12810 (BM). ''Rocky crevices (frequent to abundant) even in arid areas such as watershed and 'Hubban' orchard shrubbery, but at this season the fronds are all dried up and brittle.''

I. SOUTHERN ARABIA: Dhofar Mountains: Wadi Gerzid, 1895, *Bent* 75 (K).—I think that the above-mentioned Wadi is the same as that mentioned by T. Bent and M. V. A. Bent[19] as ''Wadi Ghersid'' and on the map in the same volume as ''Wadi Gharzid.'' The specimen was collected in the winter of 1895.

J. SOUTHERN ARABIA: Hadramaut: Kilah, 3000 feet, 3 Jan., 1894, *W. Lunt* 133 (K). ''Dwarf fern 2 inches high.''—I interpret this locality as the place quoted by Bent in the above-mentioned book as ''Khaila'' in the text and as ''Khailah'' on the map. However, the altitude of this locality on the map is 2015 feet. Kailah lies to the north of Mokalla. William Lunt was a

[16] Revoil, G. La Vallée du Darror. Paris, 1882.

[17] Franchet, A. Sertulum somalense. In G. Revoil, Faune et Flore des Pays Çomalis. Paris, 1882.

[18] Balfour, J. B. Botany of Socotra. Trans. R. Soc. Edinburgh 31: pp. I–LXXV, 1–446. 1888.

[19] Bent, T. and M. V. A. Bent. Southern Arabia. London, 1900.

young gardener from Kew who accompanied Mr. and Mrs. Bent as a botanist on their Hadramaut Expedition.

K. ARABIA FELIX AUSTRALIS: Bilad Hodjeria ad fauces montis Masâna, 17 Apr., 1890, *A. Deflers* (Iter. Arab. Sec. 600) (G, P); Bilad Hodjeria ad fauces montis Masâna prope Haïfan, 17 Apr., 1890, *A. Deflers* (Iter. Arab. Sec. 628) (P).—The latter specimen bears another label: ''Bilad Awari, Bas el Negil, 17 Apr., 1890.'' I do not know which of these localities is the proper one; however, the localities are certainly near each other, for the date of collection is the same. I have not been able to establish the precise position of Bilad Hodjeria, Bilad Awari, or Bas el Negil, but Mount Masâna lies to the northwest of Kaukaban (Yemen) and not far from the latter village. Deflers,[20] writing about Mount Masâna, says that in the neighborhood of Kaukaban ''sur un saillie du rocher surplombant la vallée de Schibâm est un petit poste d'observation. . . . De ce point, la vue s'étend au loin sur le Beled Hamdam et sur les hauts plateaux du Serât. Au N. O. se montre la cime tabulaire du gebel Masâna.''

L. ERITREA: Mont Farakh, près d'Aïlet, 17 Fev., 1892, *G. Schweinfurth & D. Riva* 441 (S); Mont Farak, est d'Aïlet, 18 Fev., 1892, *G. Schweinfurth & D. Riva* 451 (G).—Mont Farak is a hill at the base of the eastern side of the Eritrean Plateau (498 m., lat. 15° 35′ N., long. 39° 10′ E.).

M. ABYSSINIEN: Berg Scholoda bei Adoa, 6000′ über Meer, Sept., 1842, *Schimper s.n.* (P).—Mount Scholoda is the only locality on the western side of the Abyssinian Plateau from which *Negripteris* has been obtained. I have a little doubt if the specimen was collected there; the locality needs confirmation.

In addition to the specimens cited above I have seen two specimens without precise locality:

ABYSSINIA: *Quartin-Dillon & Petit* (P).—Probably this specimen comes from the mountains of northern Abyssinia, where most of the specimens of these collectors were gathered. However, we cannot establish, even approximately, the locality of collection.

SOMALILAND: 1897, *Lort Phillips s.n.* (K).—Probably this specimen comes from the Wagga Mountains. (See 2 below.)

I have thought it advisable to record on the map also three localities in which the presence of *Negripteris* is only reported or not definitely established. On the map these localities are marked by triangles and a number corresponding to the numbers below.

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[20] Deflers, A. Voyage au Yemen. Paris, 1889.

1. Negri[21] says that in the diary of his journey to southern Abyssinia *Negripteris scioana* is recorded to have been seen on the lower escarpments of the southern side of Mont Fantallè (about 1000 m.) also.

2. As I pointed out above, the specimen collected by Mr. and Mrs. Lort Phillips and labelled "Somaliland," was probably gathered in the Wagga Mountains, where these collectors gathered the greater part of their collections during their second journey to Somaliland.

3. Collenette, on the label of the specimen collected at Medisheh cited above, remarks that this fern is present at Buran also.

BOTANICAL INSTITUTE, UNIVERSITY OF FLORENCE.

A New Erect Species of the Selaginella rupestris Group

ROLLA M. TRYON, JR.

It is especially appropriate that the following new species be named for Mr. C. A. Weatherby, whose careful and painstaking studies have greatly advanced our knowledge of the species of the *Selaginella rupestris* group. The classification of the species-groups *S. oregana* and *S. Parishii* in particular has been placed on a firm foundation by his work.

Selaginella Weatherbiana, sp. nov. Planta 5–15 cm. alta; caules biformes, unus prostratus repens subterraneus ad apicem radicans, alter erectus aërius basim solum radicans; folia caulium erectorum 1.3–2.0 mm. longa (seta et basi adnata excludentia), 0.4–0.5 mm. lata, subulato-linearia, ad basim convexa, ad apicem valde carinata, ciliis dentiformibus 0.03–0.06 mm. longis vel brevioribus, basi adnata circa 0.4 mm. longa, seta 0.4–0.9 mm. longa, translucente, luteo- vel subviridi-alba, plerumque laevi; sporophylla 1.6–2.0 mm. longa (seta excludentia), 0.7–0.9 mm. lata, anguste deltoideo-ovata, leviter biauriculata, ad basim convexa, ad apicem valde carinata, seta eis foliorum simili; megasporae flavae, 0.31–0.49 mm. diametro, latere commissurali reticulato-rugoso, latere altero leviter reticulato-rugoso vel sublaevi; microsporae 43–54 μ diametro.

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[21] In Pichi-Sermolli, *loc. cit.* 157.

Plant 5–15 cm. tall; *stems* of two kinds, one prostrate, creeping, subterranean, sparingly branched, sparingly rooting throughout, the other erect, aërial, 1–2 mm. in diameter, including the leaves (dry), or 2–3.5 mm. in diameter (boiled), rooting only at the base or rarely decumbent at the base and rooting in the basal half, abundantly branched, especially above the base, the branches approximate, the pinnately divided ones once-pinnate at first, becoming bipinnate; *leaves* of the prostrate stems 0.9–1.3 mm. long (excluding the seta and the adnate base), 0.4–0.7 mm. wide, oblong-ovate, whitish or pale whitish green, from nearly plane at the base of the blade to convex at the tip, the marginal cilia usually numerous, dentiform, the largest 0.03–0.05 mm. long, ascending or patent, the adnate base 0.4–0.9 mm., mostly about 0.8 mm. long; seta lacking or up to 0.4 mm. long; *vegetative leaves* of the erect stems ascending, spreading at an angle of 30°–40° in boiled material, more appressed, sometimes tightly so in the dry condition, wholly concealing the stem, 6-ranked, 1.3–2.0 mm., mostly 1.7–1.9 mm. long (excluding the seta and the adnate base), 0.4–0.5 mm. wide, subulate-linear, light olive green to gray-green, occasionally lightly glaucous, convex at the base of the blade to strongly carinate at the tip, glabrous dorsally or slightly short-pubescent at the base of the blade and on the adnate base, the marginal cilia many or few, dentiform, the largest 0.03–0.06 mm. long, more abundant and patent toward the base, fewer and ascending above, the adnate base about 0.4 mm. long, evident down to the level of the next two leaves below, the seta 0.4–0.9 mm., mostly 0.4–0.6 mm. long, translucent, yellowish or greenish white, usually smooth, occasionally slightly scabrous; *sporophylls* 1.6–2.0 mm. long (excluding the seta), 0.7–0.9 mm. wide, narrowly deltoid-ovate, slightly biauriculate, light olive green to gray-green, occasionally lightly glaucous, from strongly convex at the base to strongly carinate at the tip, glabrous dorsally, the marginal cilia numerous, dentiform, the largest 0.03–0.05 mm. long, ascending, or patent only at the very base, the seta 0.4–0.9 mm., mostly 0.5–0.7 mm. long, translucent, yellowish or greenish white, usually smooth, occasionally slightly scabrous; *megaspores* yellow, 0.31–0.49 mm., mostly 0.37–0.41 mm. in diameter, moderately rugose-reticulate on the commissural face, obscurely rugose-reticulate or nearly smooth on the outer face; *microspores* 43–54 μ, mostly 50 μ in diameter.

Type in the herbarium of the Missouri Botanical Garden, collected at Mouth of Indian Creek, Pecos River National Forest, New Mexico, alt. about 8000 feet, July 25, 1908, by P. C. Standley (no. 4558). Fragment (US), isotype (NY).

OTHER SPECIMENS EXAMINED:

COLORADO: Pikes Peak region, Aug. 14, 1913, *J. F. Macbride* 2651 (MBG); near Minnehaha, Pikes Peak, September, 1901, *Underwood & Selby* 2 (NY); Pikes Peak, September, 1901, *Underwood* (NY); Coal Creek Canyon, southwest of Eldorado Springs, Boulder county, alt. ca. 6200 ft., June 27, 1942, *Ewan* 14370 (MBG).

NEW MEXICO: Harvey's Upper Ranch, Pecos River National Forest, alt. ca. 9600 ft., Aug. 1, 1908, *Standley* 4626 (MBG, NY, US); Below Winsor's Ranch, Pecos River National Forest, alt. ca. 8300 ft., July 3, 1908, *Standley* 4158 (US); East fork of Gallinas river, El Provenir, San Miguel County, Oct. 23, 1939, *Drouet & Richards* 3337 (MBG).

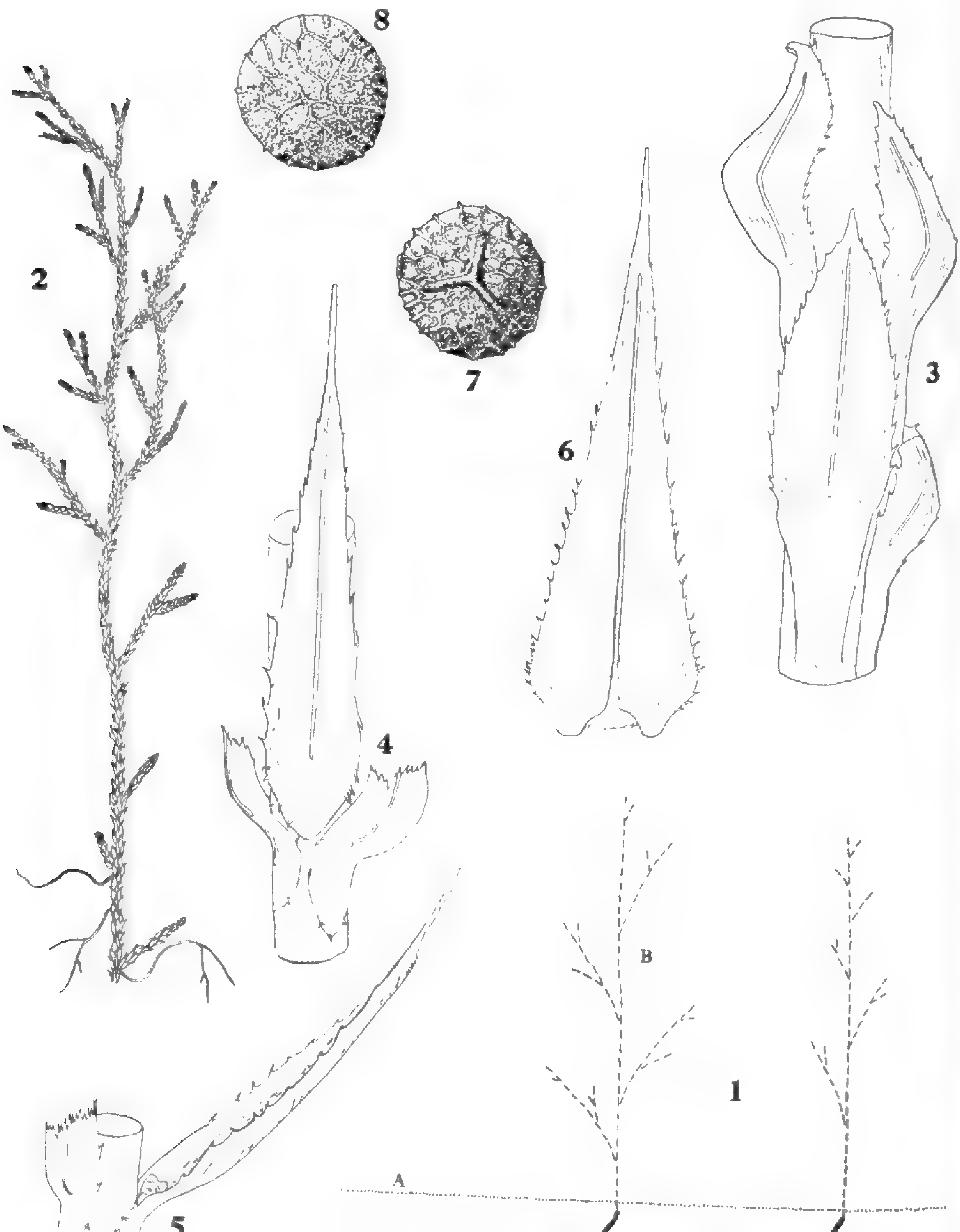
Selaginella Weatherbiana has been generally passing in the herbarium as *S. Underwoodii*. It may be sufficiently distinguished from that species and from the other erect species of the *S. rupestris* group as follows:

S. Coryi has the leaves muticous rather than setiferous, the vegetative leaves short-adnate rather than long-adnate to the stem, and the stems, including the leaves, slenderer, 0.5–0.75 mm. in diameter (dry).

S. Bigelovii, *S. rupincola* and *S. neomexicana* all have the vegetative leaves abruptly adnate to the stem rather than long-adnate; the latter two species also have the marginal cilia piliform rather than dentiform; in *S. rupincola* these are especially long and patent.

S. tortipila has tortuous and deciduous tips on the setae.

S. arenicola and *S. acanthonota* have broadly deltoid-ovate and strongly biauriculate sporophylls rather than narrowly deltoid-ovate and slightly biauriculate ones. They are also distinguished by their habit of growth. These two species have only erect, aërial stems. At first a branch is elongate and simple, later lateral branches are produced. The basal ones function as buds and remain short, the upper ones elongate and may rebranch. They produce either strobili which die after maturity or



SELAGINELLA WEATHERBIANA (FIGS. 2–8 DRAWN FROM THE TYPE). FIG. 1. DIAGRAM OF A PLANT, A, GROUND LEVEL, B, AERIAL STEM, C, SUBTERRANEAN STEM, D, LATERAL BUD, E, GROWING TIPS OF THE SUBTERRANEAN STEM; FIG. 2. AERIAL STEM, × ¾; FIG. 3. LEAVES OF SUBTERRANEAN STEM, × 20; FIG. 4. LEAF OF AERIAL STEM, DORSAL VIEW, × 20; FIG. 5. LEAF OF AERIAL STEM, × 20; FIG. 6. SPOROPHYLL, DORSAL VIEW, × 20; FIG. 7. MEGASPORE, COMMISSURAL FACE, × 35; FIG. 8. MEGASPORE, OUTER FACE, × 35.

vegetative branches which continue growth. Eventually all of the growing tips have developed into strobili and the entire upper branch system dies. At this time the short basal branches become active, elongate and each may produce a new branch system following the course of events outlined. In *S. Weatherbiana* there are two types of stems, one prostrate and subterranean, the other erect and aërial. The subterranean stem produces three kinds of branches; one is a replica of itself, elongate with the leaves distant; another is a short compact lateral branch (a bud), with the leaves small and closely imbricate; the third is an erect aërial branch with green leaves. That is, a growing tip of the subterranean stem may continue its growth, may produce a lateral bud or may produce an erect aërial stem. The lateral bud develops, after a time, either into a subterranean branch or into an erect aërial branch. The aërial stem may be pinnately branched, or it may be bipinnate or of a more complicated type. The strobili die after maturity but strobili are not produced by all of the growing tips. The branch system dies eventually, although a number of potentially active vegetative branches are still present.

The type of growth habit may be an important character, particularly useful in establishing relations between species, but due to the inadequate nature of most herbarium material I have not been able to describe it in other species.

S. Riddellii has the lateral branches strictly erect rather than ascending; the sporophylls are broadly rather than narrowly deltoid-ovate and strongly rather than slightly biauriculate.

S. Underwoodii has an epigeous stem that is rooted throughout, narrower vegetative leaves ($2–2.5 \times 0.3–0.4$ mm.) and strongly biauriculate sporophylls.

S. Weatherbiana appears to be most closely related to *S. Riddellii* and *S. Underwoodii.* All have the leaf base long-adnate to the stem. It shares the erect habit with *S. Riddellii* and the megaspores are similar. The color and general aspect of the leaves are quite similar to those of *S. Underwoodii.*

I am indebted to my wife for aid in the preparation of the plate.

MISSOURI BOTANICAL GARDEN.

Lycopodium carolinianum in Tropical Africa

F. BALLARD

Lycopodium carolinianum L. appears in the first edition of the Species Plantarum,[1] the name being based on the description and figure in Dillenius' Historia Muscorum[2] of "*Lycopodium pinnatum repens, spicis et pediculis singularibus longis.*" There is no specimen of the species in the Linnean Herbarium in London, but in the herbarium of Dillenius, preserved at Oxford, the writer has had the privilege of examining the specimen which formed the basis of the description and figure in the "Historia." This specimen, which is thus the type, is stated by Dillenius to have been collected in Carolina by one Marcus Catesby. The sheet on which it is mounted contains three other specimens of *Lycopodium:* one of *L. inundatum*, one of *L. alopecuroides* and another which may also be *L. alopecuroides.* The sheet, in fact, represents the plants portrayed on *pl. 62* of the Historia. Although in figure 6 of the plate the figure of our species is shown bearing three fruiting spikes, the specimen itself possesses only one. This may be a case of artists' license, since the spikes certainly appear to be unnaturally crowded in the figure. There is no doubt, however, that the specimen is an American one and the figure an accurate representation of it.

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1 Linnaeus, Species Plantarum 1104. 1753.
2 Historia Muscorum 452, *pl. 62, fig. 6.* 1741.

The species has been recorded from widely separated localities in America, tropical Africa, the Mascarene Islands, and tropical Asia. In a group so ancient as the Lycopods such a diffuse distribution excites no surprise though, as one might expect, geographical isolation over a long period of time has led to the production of a number of distinct regional types. In H. Nessel's revision of the genus,[3] these members of what one might call the "*carolinianum* complex" have received the status of varieties. Fourteen of these so-called varieties, in addition to the type variety, are listed, accompanied by a "key" to their identification which the present writer finds quite unworkable. In addition, the author displays an extraordinary ignorance of even the basic principles of botanical nomenclature.

Of the fifteen "varieties," the tropical American *L. paradoxum* Mart. certainly merits specific distinction, though the writer has not yet had time to study the claims of other "varieties" occurring outside the continent of Africa.

The members of the *carolinianum* complex as a whole are inhabitants of damp situations, frequently in acid boggy places. They all agree in possessing a creeping, branching aërial stem which is firmly fixed at frequent intervals by adventitious roots. The leaves are dimorphic, or, as we shall see later, even trimorphic. The prothalli of the North American type have been described by H. Koster,[4] who discovered quantities of them in a New Jersey bog. They proved to be terrestrial and green, agreeing in this respect with the prothalli of *L. alopecuroides* L. and *L. adpressum* (Chapm.) Lloyd & Underw., two other swamp plants occurring in the southern United States. Koster's discovery that in all

[3] Die Bärlappgewächse, 1939.

[4] THIS JOURNAL 31: 53. 1941.

three species prothalli develop within a few months of sowing is in accord with Holloway's observations on *L. cernuum, L. ramulosum* and *L. laterale,* all damp-loving species, in which these structures were fully developed within one season. Both Holloway and Koster found that these species, characteristic of damp habitats, developed green or partly green terrestrial prothalli, smaller, more delicate and shorter-lived than the subterranean saprophytic type found in species peculiar to drier situations.

The writer was led to an investigation of the African members of the complex by specimens collected by one of his colleagues, Mr. E. Milne-Redhead, in the Mwinilunga District of Northern Rhodesia in 1937. The specimens which were small and apparently quite young bore fruiting spikes in most cases. The stems were only 3 to 5 cm. in length, with a few short branches, and bore few adventitious roots. The plants arose from slender upright leafless stems, a few centimeters in length, which terminated below in small fleshy tubers which ranged from 10 to 15 mm. long and 5 to 6 mm. across. The tubers were closely invested in scale leaves and bore a few roots. (*Pl. 10, fig. A*).

The appearance of these tuberous plants was at first sight somewhat puzzling and it was only after a close examination of the African material of *L. carolinianum* at Kew and the British Museum that the situation became clear. One or two of the larger specimens exhibited swellings either at the end of a main stem or a short branch. On these swollen tips the leaves were minute and crowded and the whole structure had an etiolated appearance. These incipient tubers had long ago been noted by Welwitsch and resulted in the description of *L. tuberosum* A. Br. & Welw.[5] Welwitsch described the

[5] In Kuhn, Fil. Afr. 211. 1868.

tubers as 10 mm. long and 5 mm. broad, but his own specimens from Angola show only the beginnings of tuber formation and the prescence of tubers is easily overlooked.

Apparently, tuber formation takes place towards the end of the rainy season. The swollen tips of the branches presumably become positively geotropic and bury themselves in the soft, often muddy substratum. During the hot dry season they remain safely below ground while the parent plant shrivels and probably dies away. When the wet season begins, the tubers, stored with reserve food, develop quickly into fresh plants from the original meristematic tissue at the apex.

Welwitsch not unnaturally regarded the tuberous character as a specific one but it seems clear from the examination of a mass of material from Africa that it is rather a response to climatic conditions and that all variants of *L. carolinianum* in Africa are facultatively tuberous. It seems more than likely that propagation of the species in tropical Africa is almost entirely vegetative. Holloway expressed the same opinion with regard to the New Zealand species. In the case of terrestrial prothalli, as in *L. carolinianum,* their delicate nature renders them particularly vulnerable to conditions of drought. The tuberous habit, therefore, would seem to be an admirable device for ensuring the continuance of the species under adverse climatic conditions.

ANATOMY

An examination of the stelar structure of North American and African members of the complex shows that they all conform in general to the type illustrated by *L. laterale.*[6] In transverse section the structure is seen to be a mixed one with curved bands and groups of metaxylem interspersed with phloem elements. The

[6] Holloway, Trans. N. Zeal. Inst. **48**: 291. 1916; **51**: 183. 1919.

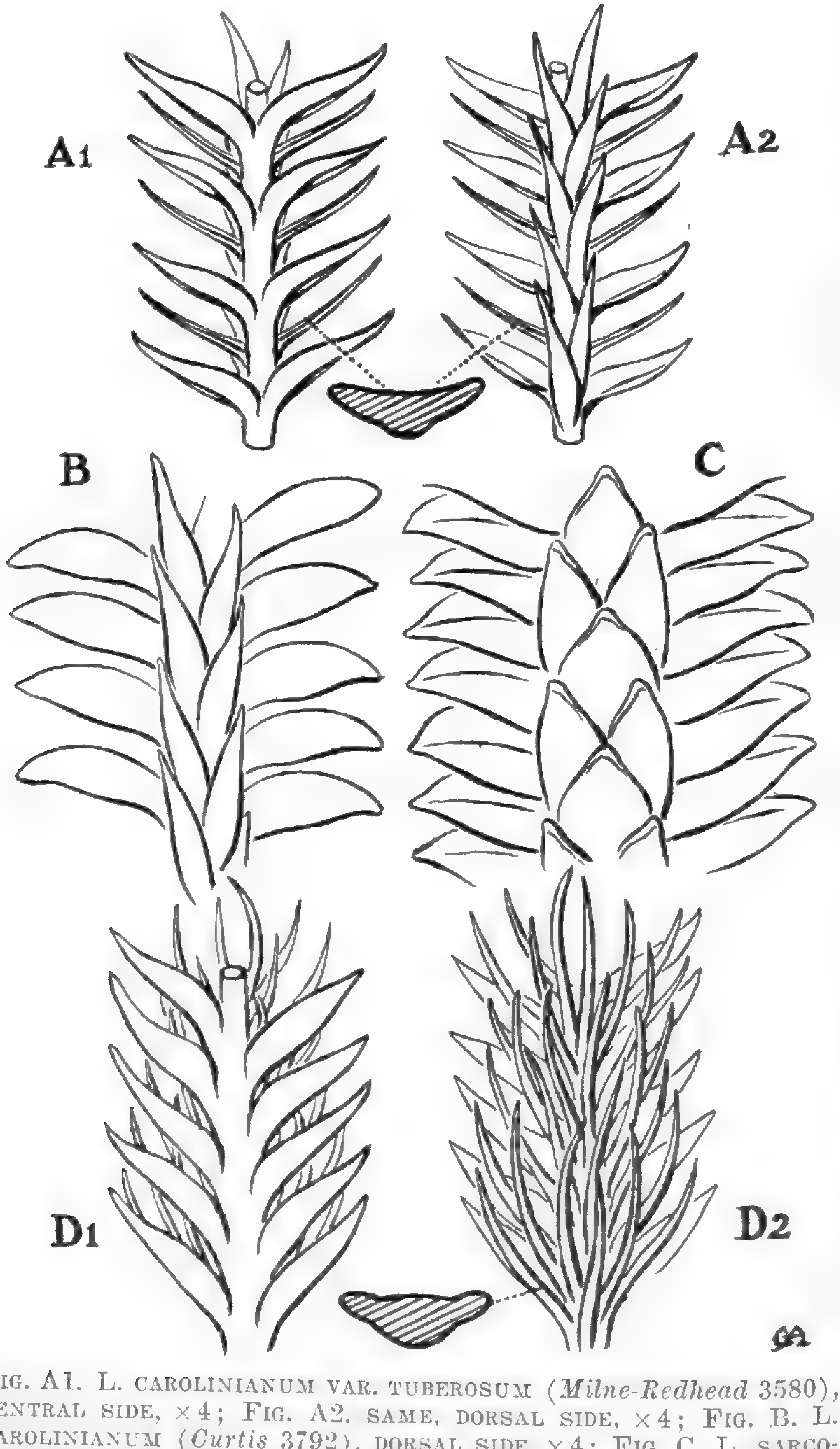

FIG. A1. L. CAROLINIANUM VAR. TUBEROSUM (*Milne-Redhead* 3580), VENTRAL SIDE, ×4; FIG. A2. SAME, DORSAL SIDE, ×4; FIG. B. L. CAROLINIANUM (*Curtis* 3792), DORSAL SIDE, ×4; FIG. C. L. SARCOCAULON (*Fries* 2667), DORSAL SIDE, ×4; FIG. D1. L. CAROLINIANUM VAR. TUBEROSUM (*Greenway* 5353), VENTRAL SIDE, ×4; FIG. D2. SAME, DORSAL SIDE, ×4 number of protoxylem groups varies from seven to twelve and these become more or less extended around the periphery of the stele. There is no suggestion of the parallel plates of vascular tissue which Holloway found in certain New Zealand plagiotropic species.

There is a sclerenchymatous sheath in close proximity to the stele around which is a more or less spongy cortical parenchyma. This tissue varies greatly in amount in the African plants. In the slender stems of the type represented by *Milne-Redhead* 3580 (*Pl. 10, fig. A*) there is very little cortical tissue; in the typcial var. *tuberosum* as in *Greenway* 5353 (*Pl. 10, fig. D*) there is much more, while in *L. sarcocaulon* (*Pl. 10, fig. C*) which is fleshy in the living state, there is an abundance of spongy parenchyma traversed by a particularly slender stele. In this species, also, the cortical cells are somewhat peculiar. They appear to be subspherical in shape and are attached mutually by numerous disc-like areas which are perforated by simple pits. A similar condition is seen in the fleshy leaves of species of *Sansevieria* (Liliaceae). When the cells are turgid there are few intercellular spaces, but when water is lost and the cells become flaccid the walls collapse inwards between the pore-plates. Thus, cell continuity is effectively maintained and the numerous pits allow the rapid absorption of liquid as soon as free water becomes available. To a very much lesser extent this type of tissue is seen in the American *L. carolinianum* and indeed in all the African members as well.

There is nothing peculiar about the structure of the tubers. The stele is substantially the same as that of the aërial stem, of which, of course, it is the modified apical portion. At the apex, however, in the case of the tuber figured (*Pl. 10, fig. A*), the stele becomes an almost solid mass of xylem with minute islands of phloem appearing here and there among the tracheids. The cortical tissue is extensive and functionally food-storing.

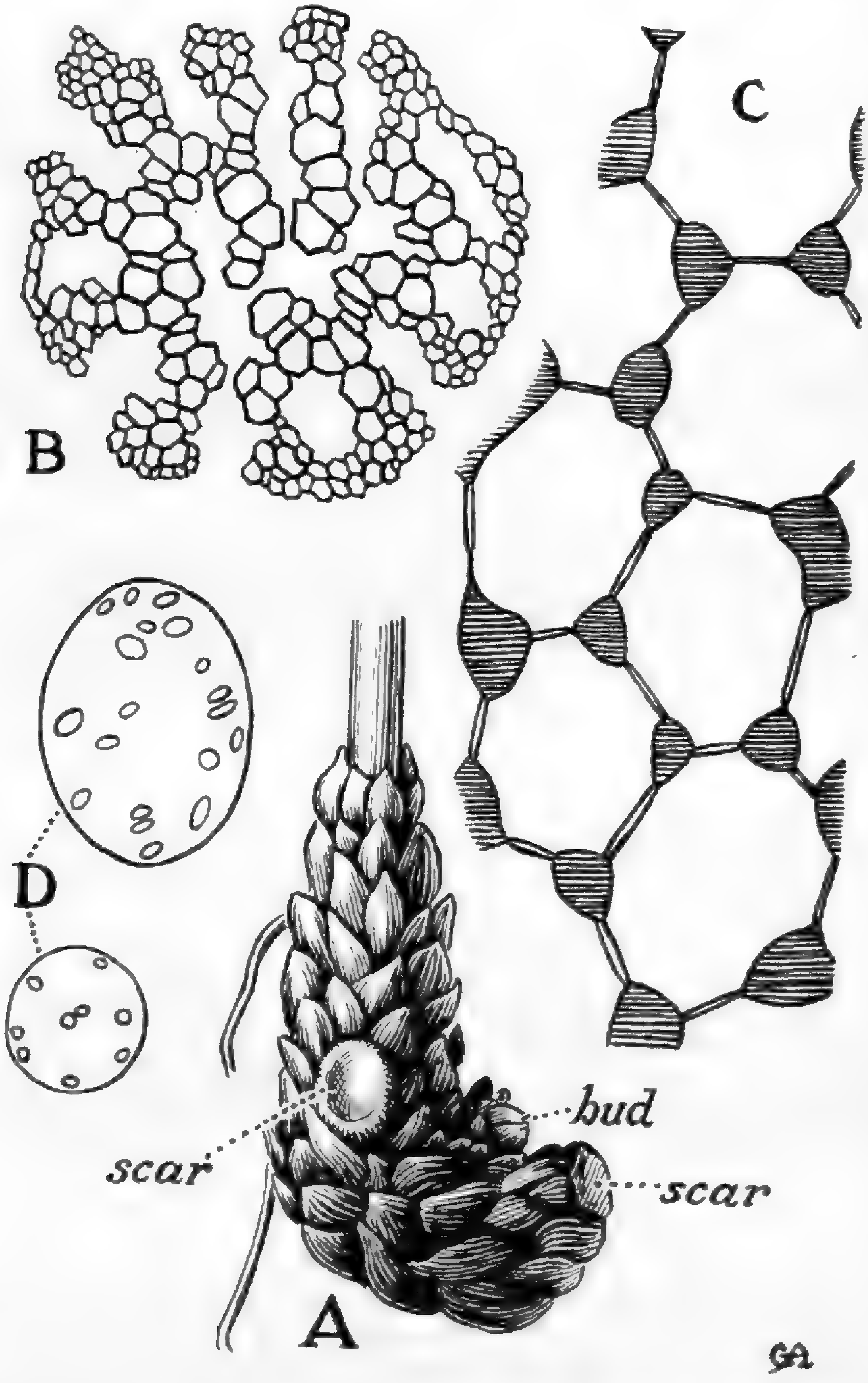

FIG. A. L. CAROLINIANUM VAR. TUBEROSUM (*Milne-Redhead* 3580), STEM TUBER, ×4; FIG. B. SAME, STELE IN CROSS-SECTION OF AERIAL STEM, XYLEM ONLY, ×240; FIG. C. L. SARCOCAULON (*Milne-Redhead* 4163), CORTICAL CELLS OF STEM, SOMEWHAT DIAGRAMMATIC, AIR-SPACES HATCHED, ×240; FIG. D. SAME, PORE PLATES FROM CORTICAL CELLS, ×C. 720

MORPHOLOGY AND TAXONOMY

It became clear early in the investigation that *L. sarcocaulon* A. Br. & Welw. ex Kuhn should retain its specific status. Though regarded by Spring and Nessel as a variety of *L. carolinianum* it differs so much from that species that its segregation as a distinct species seemed the only logical treatment. It bears a resemblance to the Brazilian *L. carnosum* Alv. Silv. and specimens have been seen from Paraguay (*Hassler* 8340) which are also very similar. *Lycopodium sarcocaulon* is a stout fleshy plant with a somewhat flattened axis with closely overlapping rigid fleshy leaves. It is said by collectors to be very brittle and certainly seems to break up very easily in a botanical press. The cones are large and are borne on a sturdy axis. The spores were examined but could not be distinguished either from those of the American type or from var. *tuberosum*. Specimens of *L. sarcocaulon* have been seen from Angola, Southern Rhodesia, Nyasaland, the Transvaal, and Natal.

In his revision Nessel records the type variety of the species from Liberia. The specimens cited by him have not been seen by the writer, but the few Liberian collections that have been examined are quite unlike the American type. A character that strikes one forcibly on examining a large number of sheets of African *L. carolinianum* is the stouter nature of the strobilus when compared with American material. A rough series of measurements of strobili of thirteen American collections disclosed that the average length was 60.7 mm. and the average diameter 2.3 mm. The ratio length/breadth was 26. On a corresponding series of African specimens the average length proved to be 37.5 mm. and average diameter 2.6 mm. The ratio length/breadth was 14. The measurement in all cases was taken from mature strobili, the diameter measurement being taken across the middle.

Such a test on a limited number of specimens might not satisfy the statistician, but the ratios of length to breadth differ so widely in the two cases that a fair degree of error could be admitted.

After removing *L. sarcocaulon* from the ambit of *L. carolinianum* in the stricter sense, some difficulty has been experienced in deciding whether one or two varieties can be distinguished in tropical Africa. When the Milne-Redhead specimens were being examined, it became apparent that the leaves were of three kinds. A glance at *Plate 9, fig. A* will show the wide spacing of the leaves which are generally narrower than those of the type. The lowermost two rows are ovate-lanceolate and spreading. The uppermost two rows are lanceolate and flat and tend to be parallel to the stem. The two lateral rows, however, are strongly divergent and somewhat acicular. An examination was then made of Welwitsch's type material of *L. tuberosum* from Angola, in which, however, the leaves appeared to be normally dimorphic. Here the uppermost four rows of leaves were all subacicular and somewhat spreading. They were also denser than in the Rhodesian specimens. In fact, there appeared to be a strong case for regarding the latter plant as a new variety or subspecies of *L. carolinianum*.

A thorough study of all the African material at Kew and at the British Museum has shown, nevertheless, what appears to be a series of transition forms between these two extremes. Holloway[7] has already commented on the marked "plasticity" of the New Zealand species of *Lycopodium* in the field under varying ecological conditions. Although no field studies have been carried out on the African plants, we may reasonably assume a similar degree of plasticity. The species has been recorded from places as far apart as Liberia and Southern

[7] Trans. N. Zeal. Inst. **51**: 161. 1919.

Rhodesia. Ecological conditions over such an area must vary widely and in response to them a number of morphological variants may arise. If, as is probably the case, propagation is mainly vegetative, these various populations really consist of clones. It is possible, of course, that some of these forms may be genetically stable, but only the cytogeneticist can be of real assistance to us here. On the evidence of herbarium specimens alone we are on safer ground in regarding them all as manifestations of a variable variety, *L. carolinianum* L. var. *tuberosum* (A. Br. & Welw. ex Kuhn) Nessel.

Specimens of the variety have been seen from French Sudan, Liberia, Sierra Leone, Cameroons, Belgian Congo, Angola, Uganda, Tanganyika, Rhodesia and Nyasaland.

ROYAL BOTANIC GARDENS, *Kew*.

Ferns, Microscopes, and Brownian Movement

R. C. BENEDICT

In 1828, Robert Brown, the Scottish botanist who has been described as "botanicorum facile princeps," published a report of a study of minute particles in liquids. The movements of these particles which he observed first in pollen grains have come to be known as "Brownian movements." His discovery has come to be recognized as of even greater significance for the physical sciences than for botany: "Brownian movements provided visual demonstation of the reality of the heat motion postulated by the Kinetic Theory."[1] Brown's discovery provided a single but striking step in the more than 2000-year development of the "atomic theory" of Leucippus and Democritus. While his first purpose in the study had been to gain more knowledge regarding the processes involved in "fecundation" in flowering plants, the title of

[1] Encycl. Brit. 11th ed.

his article[2] "A brief account of microscopical observations made in the months of June, July, and August 1827, on the particles contained in the pollen of plants; and on the general existence of active molecules in organic and inorganic bodies," gives evidence that he was not unaware of the possible general significance of his findings. Of this contribution, the editor of the Edinburgh Journal makes the following foot-note observation: "This important and highly interesting Memoir was sent to us by our friend, Mr. Brown, and, although not published, we believe we are not acting contrary to the wishes of the author in giving it an early place in the Edinburgh Philosophical Journal."

The recent acquisition of a copy of the original publication by the Brooklyn College Library brought to light two very interesting facts which seem to have been definitely overlooked. First, although Brown dealt mainly with various kinds of pollen material—he was seeking to find out whether the movements of the pollen grain materials could be traced down into the chambers of the ovulary—he did include also two types of "fern" material in his studies. Second, although compound microscopes had been constructed and used at least since the days of Galileo in 1610, and extensively dealt with by Hooke and others during the 17th and 18th centuries, Brown used for his studies of the minute particles involved chiefly a simple microscope, a single lens of one thirty-second inch focal length.

The word "molecule" like the word "atom" has gone through several modifications and restrictions of meaning. To Brown, the minute spherical particles, which he observed first in the pollen grains of *Clarkia pulchella*, were "elementary active molecules." In the course of his three months of study, he applied the same term to

[2] Edinburgh New Philosophical Journal, April–September 358–371. 1828.

similar small granules which he observed in a wide variety of materials: various other pollen preparations, haddock, and a variety of dead organic and inorganic material. Today, such particles are recognized as usually multi-molecular aggregates, but their visible vibratory motion, Brownian movement, is counted as ocular evidence of the buffeting they receive from the much smaller actual molecules, as the term is used today.

Fern material comes into the picture in two comments:[3] "The fine powder produced on the under surface of the fronds of several ferns, particularly of *Acrostichum* (*Gymnogramma*) *calomelanos*, and the species nearly related to it, was found to be entirely composed of simple molecules, and their primary fibre-like compounds, both of them being evidently in motion." Again, as a footnote: "While this sheet was passing through the press, Mr. Dollond at my request, obligingly examined the supposed pollen of *Equisetum virgatum* with his compound achromatice microscope, having at its focus a glass divided into 10,000ths of an inch, upon which the object was placed; and although the greater number of particles or molecules were about 1/20,000, yet the smaller did not exceed 1/30,000 of an inch."

The reference to the *Equisetum* material was largely incidental to certain general phases of the whole problem of the movement of the "elementary molecules," which Brown outlines as follows: "There are three points of great importance which I am anxious to ascertain respecting these molecules, namely their form, whether they are of uniform size, and their absolute magnitude. I am not, however, entirely satisfied with what I have been able to ascertain on any of these points."

In concluding his general discussion of the occurrence of these "elementary molecules" Brown mentioned the

[3] Loc. cit. 366.

principal substances from which he had not been able to obtain them: "These are oil, resin, wax, and sulphur, such of the metals as I could not reduce to that minute size necessary for their separation, and finally, bodies soluble in water."

Regarding the kind of microscope used, Brown's very precise statements as to the instrument used serve to focus attention on what is still one of the most widely publicized mistakes relating to the history of the invention of microscopes. Textbooks, of college as well as high school level, speak of the "Dutch inventor of the microscope, Leeuwenhoek," usually with the implication that the compound instrument is referred to, although Leeuwenhoek used only simple lenses, as can be discovered in Charles Singer's works or in those of other historians of scientific progress. Brown leaves nothing in doubt. The first paragraph of his paper reads as follows: "The observations of which it is my object to give a summary in the following pages, have all been made with a simple microscope, and indeed with one and the same lens, the focal length of which is 1/32d of an inch." To this is appended a footnote: "This double convex lens, which has been several years in my possession, I obtained from Mr. Banks, optician in the Strand. After I had made considerable progress in the enquiry I explained the nature of my subject to Mr. Dollond,[4] who obligingly made for me a simple pocket microscope, having a very delicate adjustment, and furnished with excellent lenses, two of which are of much higher power than that above mentioned. To these I have often had recourse, and with great advantage, in investigating several minute points. But to give greater consistency to my statements, and to bring the subject as much as possible

[4] Banks and Dollond were two of the chief English manufacturers of microscopes, both simple and compound, beginning in the late eighteenth century.

within the reach of general observation, I continued to employ throughout the whole of the enquiry the same lens with which it was commenced."

Two general comments seem relevant. It is a surprising fact that nearly 240 years after the first compound microscope was constructed (Jansen, 1590), simple instruments could continue to be preferred, and could be used as effectively as demonstrated by Robert Brown for very minute objects. It is surprising, also, to discover that relatively little is known regarding the particular kind of instrument used by many of the pioneer workers in the field of biology. The very painstaking study by Disney and others on the "Origin and development of the microscope"[5] notes that Swammerdam used simple microscopes, but finds no data given regarding the instruments used by Grew or Malpighi.

Supplementing the preceding and indicative of one reason for a decline in the use of microscopes in biological work during the 18th century, some interesting comments by Matthew J. Schleiden have just come to hand. It is a familiar observation that knowledge of minute anatomy of living things made little if any progress for well over one hundred years, from the time of the discoveries of Grew, Malpighi, Swammerdam, and Leeuwenhoek toward the end of the 17th century, until well into the 19th century. Schleiden, in a popular series of lectures, published in an English translation in 1848, under the title, "The Plant; A Biography"[6] places much of the blame on Linnaeus.

"There can, however, be no possible doubt that it indicates a most barbarous age, or a very low state of refinement, when the value, the importance of a thing is meas-

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[5] Royal Microscopical Society, 1928.

[6] The Plant; A Biography, in a series of popular lectures. Translated by Arthur Henfrey. London. 1848.

ured by great and small, a standard indeed which finds no application in all that we know most essential and valuable, for the human mind is not to be defined by foot, inch or line. Physical magnitude imposes only on the sensuous nature; cultivated man seeks to know the object of his contemplation perfectly in all its relations; and then only, from the perfect knowledge, does he permit himself to judge as to the essential and unessential; very frequently this leads him to declare that most significant which has the smallest dimensions.

"This observation is especially applicable to Botany. There was an era in this science, in which it began to work its way out of the mediaeval night of Nothing: when, therefore, only its crudest elements existed; this was the era of the Linnaean school. We wish not to detract from the merit of Linnaeus, since greater is the glory to discover, to shape out a science, than to build it upward after the foundations have been laid; we wish not, as we have said, to disparage Linnaeus when we describe him as the author of one of the saddest of prejudices, which has long kept Botany in the lowest condition, and even now is not so totally overthrown but that its evil operations are still, in many ways, obstacles in the onward path of science. We mean Linnaeus' objection to the microscope, and his contempt of all knowledge only to be obtained by its help. The influence of Linnaeus was so pernicious in this respect, that almost all that had already been achieved by a few most distinguished men, particularly by Malpighi, at the close of the seventeenth century, became so completely lost to science in the eighteenth, that in the beginning of the present century, even the most excellent observers did not by a long way attain to the rank of Malpighi in all points."

BROOKLYN COLLEGE.

Ferns of the Monterrey Region, Mexico

ROBERT T. CLAUSEN

Monterrey is the largest city in northern Mexico and capital of the state of Nuevo León. It is joined by the Pan American Highway with Laredo, Texas, and Mexico City. A good highway extends from Monterrey westward to Saltillo which is located on the one hundred and first meridian. Because of Monterrey's strategic position, it is visited each year by many people from the United States. Some spend a few days there and then return to Texas. Others simply stop overnight on the way to more distant points. Since accommodations for visitors are many and good, members of the Fern Society may wish to make this city their headquarters while they survey the interesting ferns of the mountains roundabout. All species which are listed below from the quadrangle (25°–26° N., 100°–101° W.) can be seen on trips of a day's duration from Monterrey.

The area under discussion is semiarid, mountainous country. It is located towards the northern end of the eastern Sierra Madre, but on the west includes a portion of the central plateau and in the northeast a lobe of the Coastal Plain. The rocks are preponderantly limestone, with the strata much folded. Those of the mountains are of Lower Cretaceous or Jurassic Age, but those in the north and also the plateau and Coastal Plain portions are of Upper Cretaceous age. The altitudinal range is from 300 meters on the Coastal Plain to 3600 meters in the mountains. The temperature varies with the altitude, whereas the rainfall decreases westward and is least on the plateau. The following statistics from a paper on the climatology of Mexico by Contreras Arias (1942) indicate the situation:

Villa de Santiago, long. 100° 8′ W., alt. 445 m., aver. ann. temp. 21.7° C., aver. ann. rainfall 1039 mm.

Monterrey, long. 100° 18′ W., alt. 538 m. aver. ann. temp. 21.8° C., aver. ann. rainfall 718 mm.

Ramos Arizpe, long. 100° 58′ W., alt. 1399 m., aver. ann. temp. 18° C., aver. ann. rainfall, 251 mm.

Dr. Edward Palmer was among the first to collect ferns in the region around Monterrey. Most of the earlier botanists who wrote on the ferns of Mexico concerned themselves with the species of the central and southern portions of the country, without allusions to the northern regions. Palmer collected in 1880 two specimens which became types of new species from the present area. Subsequently, from 1888 to 1908, C. G. Pringle, of Charlotte, Vermont, collected intensively in the vicinity of Monterrey and added much to the knowledge of the flora of the region, including three species of ferns new to science. Since Pringle's time, many botanists have passed through Monterrey and several have made collections in the vicinity.

In 1949, I spent much of April and the first days of May in the Monterrey area. On my visit I had a chance to collect ferns while engaged in a taxonomic study of *Sedum* in the eastern Sierra Madre. This work on *Sedum* had the generous support of grants from the American Philosophical Society and the Torrey Botanical Club; also I was accorded various courtesies by the Mexican Department of Agriculture.

The purpose of this article is to enumerate some of the ferns which a prospective traveler may expect to see in the vicinity of Monterrey. No such list is available, although an excellent one was published by Mr. Weatherby (1943) for Coahuila and adjacent portions of Chihuahua, Durango and Zacatecas. The Flora Taxonomica Mexicana by Conzatti (1946) is useful, but it does not include eleven of the species known from the area under discussion.

The present list of ferns is not complete. My attention to ferns being only incidental, I must have missed several, perhaps many species. Further, I have not had time to examine the various big herbaria which might add additional species to my list. The sources of information for this account have been my own collections, the collections available in the Wiegand Herbarium of Cornell University (CU), and the literature in the Cornell libraries. My collections still are not distributed, but eventually a set will be placed in the Wiegand Herbarium and duplicate sets will be sent to the United State National Herbarium, the Arnold Arboretum of Harvard University, and the Instituto de Biologia in Mexico City.

A list of a few easily accessible localities with ferns to be found there may be useful to prospective visitors.

Saddle Mountain, southeast of Monterrey: *Cheilanthes leucopoda, Notholaena rigida, Asplenium resiliens, Phanerophlebia auriculata.*

Huajuco Canyon, 37 km. southeast of Monterrey: *Adiantum Capillus-veneris, Cheilanthes alabamensis, Cheilanthes microphylla, Tectaria heracleifolia.*

Horsetail Falls, southwest of Villa de Santiago: *Pteris cretica, Adiantum Capillus-veneris, Llavea cordifolia, Asplenium resiliens, Dryopteris patens, Phanerophlebia umbonata, Polypodium plesiosorum, Polypodium polypodioides.*

Huasteca Canyon, southeast of Santa Catarina: *Pteris vittata, Notholaena neglecta, Pellaea atropurpurea, Dryopteris patens.*

Mountainside below grotto near Villa de Garcia: *Cheilanthes microphylla, Notholaena delicatula.*

The complete list of ferns which I know as occurring in the Monterrey Quadrangle now follows. Brief indication of localities, altitudes and collectors is included.

[OPHIOGLOSSACEAE]

[None known from the quadrangle, but *Botrychium Lunaria* (L.) Swartz var. *minganense* (Vict.) Dole, from an elevation of 3660 meters on the Cerro Potosí, just south of 25° N., was sent me for identification in 1939 by Mr. R. A. Schneider. He had collected it there in July, 1938.]

SCHIZAEACEAE

ANEMIA ADIANTIFOLIA (L.) Swartz. Villa de Santiago, *Perkins & Hall* 3295 (CU); by river above Monterrey, *Pringle* (Davis, 1936).

ANEMIA MEXICANA Klotzsch. Guajuco, *E. Palmer* (Eaton, 1883); springs at foot of Sierra Madre, Monterrey, *Pringle* (Davis, 1936).

POLYPODIACEAE

PTERIDIUM AQUILINUM (L.) Kuhn. Cited by Tryon[1] from the Sierra Madre, Monterrey, *C. H. & M. T. Mueller* 366. According to Tryon, part of this collection is subsp. *latiusculum* ("var. *latiusculum*") and part *P. caudatum* ("var. *caudatum*").

PTERIDIUM CAUDATUM (L.) Maxon. Reported as *P. aquilinum* var. *caudatum* by Tryon (*l.c.*).

PTERIS CRETICA L. Steep rocky slope on north side of Horsetail Falls, 915 m., *Clausen* 7554, *Perkins & Hall* 3284 (CU).

PTERIS VITTATA L. Moist, muddy bank, over limestone, Huasteca Canyon, ±900 m., *Clausen* 7640. Apparently not previously reported from this part of Mexico.

ADIANTUM CAPILLUS-VENERIS L. Huajuco Canyon, 620 m., *Clausen* 7542; Horsetail Falls, *Perkins & Hall* 3275 (CU); Chorro Grande, *Palmer* 360 (Weatherby, 1943).

ADIANTUM TENERUM Swartz. Guajuco, *Palmer* (Eaton, 1883).

ADIANTUM TRICHOLEPIS Fée. Near Monterrey, *Pringle* (Davis, 1936).

["*Adiantum trichiatum* Rosenstock". Monterrey, *Arsène* (Conzatti, 1946). I do not know this species.]

CHEILANTHES AEMULA Maxon. Shaded banks near Monterrey, *Pringle* 1988, according to Maxon.[2]

CHEILANTHES ALABAMENSIS (Buckl.) Kunze. Huajuco Canyon, 610 m., *Clausen* 7541a; Guajuco, *Palmer* (Eaton, 1883); San Lorenzo Canyon, 10 km. southeast of Saltillo, *Palmer* (Weatherby, 1943).

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[1] Rhodora **43**: 47. 1941.

[2] Contr. U. S. Nat. Herb. **10**: 496. 1908.

CHEILANTHES CASTANEA Maxon. Mountains 10 km. east of Saltillo, *Palmer* 1398 (Weatherby, 1943); in crevices of limestone on hill south of Ramos Arizpe, *Clausen* 7611. The leaves of *Clausen* 7611 have the fewer, larger segments mentioned by Maxon,[3] also they are distinct and green on the upper surface, though loosely tomentulose, but the hairs on the under side are pale brown, not rich tawny.

CHEILANTHES EATONI Baker. Guajuco, *Palmer* (Eaton, 1883); road to Diamante Pass, southeast of Saltillo, *Johnston* 7270 (Weatherby, 1943).

CHEILANTHES FEEI Moore. Chorro Grande, *Palmer* 374 (Weatherby, 1943).

CHEILANTHES HORRIDULA Maxon. Vicinity of Monterrey, *Pringle* (Davenport,[4] as *C. aspera*).

CHEILANTHES JAMAICENSIS Maxon. Mountains 10 km. east of Saltillo, *Palmer* 1418 in pt. (Weatherby, 1943).

[CHEILANTHES KAULFUSSII Kunze. Not definitely reported from the Monterrey Quadrangle, but found nearby (26° 16′ N., 99° 59′ W.) in crevices of sandstone in canyon on north side of Cerro Sombreretillo, alt. 610 m., *Clausen* 7618.]

CHEILANTHES LEUCOPODA Link. Among limestone rocks in canyon on west side of Saddle Mt., 800 m., *Clausen* 7566.

CHEILANTHES MEIFOLIA D. C. Eaton. Guajuco, *Palmer* 1377, type (Eaton, 1883).

CHEILANTHES MICROPHYLLA Swartz. Huajuco Canyon, 610 m., *Clausen* 7541b; on limestone of mountainside below grotto of Villa de Garcia, 950 m., *Clausen* 7597; damp, shady ravine, Sierra Madre near Monterrey, *Pringle* (Davis, 1936).

CHEILANTHES NOTHOLAENOIDES (Desv.) Maxon. Mountains 10 km. east of Saltillo, *Palmer* (Weatherby, 1943).

CHEILANTHES TOMENTOSA Link. Guajuco, *Palmer* 1393 (Eaton, 1883).

NOTHOLAENA ASCHENBORNIANA Klotzsch. Near Monterrey, *Palmer* (Eaton, 1883); San Lorenzo Canyon, 10 km. southeast of Saltillo, *Palmer* 402 (Weatherby, 1943).

NOTHOLAENA BRYOPODA Maxon. Chalky banks at base of Sierra de San Lazaro, 2288 m., *Pringle* 8802, isotype (CU).

NOTHOLAENA CANDIDA Hooker. Guajuco and near Monterrey, *Palmer* (Eaton, 1883); Sierra Madre near Monterrey, *Pringle*.[5]

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[3] Amer. Fern Journ. **15**: 18. 1925.
[4] Gard. & Forest **4**: 448. 1891.
[5] Gard. & Forest **4**: 519. 1891.

NOTHOLAENA DELICATULA Maxon & Weatherby. On limestone of mountainside below grotto of Villa de Garcia, alt. 1050 m., *Clausen* 7600; Monterrey, *Palmer* (Weatherby[6]); in crevices of limestone on hill south of Ramos Arizpe, 1400 m., *Clausen* 7610.

NOTHOLAENA LEONINA Maxon. Near Monterrey, *Palmer* 1381, type.[7]

NOTHOLAENA LIMITANEA Maxon subsp. MEXICANA Maxon. Base of mountains southeast of Saltillo, road to Diamante Pass, *Johnston* 7269 (Weatherby, 1943).

NOTHOLAENA NEGLECTA Maxon. In crevices of limestone on north side of Huasteca Canyon, ±890 m., *Clausen* 7630. Since Weatherby (1943) stated the range as extending to eastern Coahuila, 10 km. southeast of Saltillo, this collection from 100° 27′ W., may be the easternmost for the species.

NOTHOLAENA RIGIDA Davenp. Saddle Mountain, *Pringle* 2599, type (Davis, 1936). I found this fern frequent in crevices of sandstone in a canyon on the north side of the Cerro Sombreretillo, 610 m., *Clausen* 7619. This locality (26° 16′ N., 99° 59′ W.), just northeast of the Monterrey Quadrangle, may be the northeasternmost one for the species. In the same locality was a little *Cheilanthes* which I have been unable to identify.

NOTHOLAENA SINUATA (Lag.) Kaulf. Lirios and Chorro Grande, *Palmer* (Weatherby, 1943).

PELLAEA ATROPURPUREA (L.) Link. Moist, muddy bank, over limestone, Huasteca Canyon, alt. ±900 m., *Clausen* 7639.

PELLAEA INTERMEDIA Mett. Reported from Lirios by Weatherby (1943).

PELLAEA INTRAMARGINALIS Sm. Sierra Madre near Monterrey, *Pringle* (Davis, 1936).

PELLAEA MICROPHYLLA Mett. East and southeast of Saltillo, *Palmer* (Weatherby, 1943).

PELLAEA MUCRONATA Hook. Dry hills in the vicinity of Monterrey (Conzatti, 1946, as *P. ornithopus*).

PELLAEA OVATA (Desv.) Weatherby. Monterrey, *Palmer* (Eaton, 1883). Not far outside the Monterrey Quadrangle, I collected this from crevices of sandstone in a canyon on the north side of the Cerro Sombreretillo, alt. 610 m., *Clausen* 7617.

LLAVEA CORDIFOLIA Lag. In crevices of limestone, base of cliffs on north side of Horsetail Falls, 915 m., *Clausen* 7553, *Perkins &*

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[6] Contr. Gray Herb. **127**: 8. 1939.

[7] Contr. U. S. Nat. Herb. **16**: 58. 1912.

Hall 3286 (CU); Guajuco, *Palmer* (Eaton, 1883), and canyons near Monterrey, *Pringle*.[8]

ASPLENIUM PALMERI Maxon. Reported by Weatherby (1943) from 10 km. east of Saltillo.

ASPLENIUM RESILIENS Kunze. In crevices of cliffs of limestone on north side of Horsetail Falls, *Clausen* 7557; on limestone in canyon on west side of Saddle Mountain, 1100 m., *Clausen* 7572; also reported by Weatherby (1943) from 10 km. east of Saltillo.

DRYOPTERIS PATENS (Swartz) Kuntze. Near Villa de Santiago, *Perkins & Hall* 3265 (CU); Horsetail Falls, *Perkins & Hall* 3267 (CU); *Clausen* 7559; on bank of ditch, west side of Monterrey ±550 m., *Clausen* 7641.

DRYOPTERIS RUDIS (Kunze) C. Chr. In damp shady ravine in Sierra Madre near Monterrey, and near headwaters of brook in Sierra Madre, *Pringle* (Davis, 1936).

PHANEROPHLEBIA AURICULATA Underw. In canyon on west side of Saddle Mountain, 1100 m., *Clausen* 7570; Sierra Madre near Monterrey, *Pringle* (Davis, 1936).

PHANEROPHLEBIA UMBONATA Underw. On steep rocky slope near Horsetail Falls, *Clausen* 7555, *Perkins & Hall* 3256 and 3294 (CU); shaded canyons near Monterrey, *Pringle*, type (Underwood, 1899). My specimens have the scaly rachises as mentioned by Underwood (1899), but the inner rows of sori vary from 1.5–4 mm. from the midveins of the pinnae. The number of pinnae per frond varies from 19–35. The scaly rachis may be the only absolute basis for separation of this species from *P. nobilis* (Schlecht. & Cham.) Presl. The large number of pinnae per frond is as much of a distinctive tendency in *P. umbonata* as the distance of the inner rows of sori from the midribs of the pinnae.

POLYSTICHUM ACROSTICHOIDES (Michx.) Schott. Sierra Madre near Monterrey, *Pringle*.[9]

TECTARIA HERACLEIFOLIA (Willd.) Underw. On rocks beside small waterfalls on south side of Huajuco Canyon, 620 m., *Clausen* 7543; Horsetail Falls, *Perkins & Hall* 3255 (CU); Guajuco, *Palmer* 1437 (Eaton, 1883); canyon southeast of Monterrey, *Pringle* 1983 (Davis, 1936).

POLYPODIUM PLESIOSORUM Kunze. On limestone on rocky slope by Horsetail Falls, 915 m., *Clausen* 7553, *Perkins & Hall* 3253 (CU); Villa de Santiago, *Perkins & Hall* 3249 (CU); Sierra Madre, near Monterrey, *Pringle* (Davis, 1936); Guajuco, *Palmer* 1374 (Eaton, 1883).

[8] Gard. & Forest 4: 519. 1891.
[9] Maxon, Amer. Fern Journ. 24: 23–24. 1934.

POLYPODIUM POLYPODIOIDES (L.) Watt. Horsetail Falls, observed by *Clausen;* Guajuco, *Palmer* (Eaton, 1883).

The above list comprises 47 species belonging to two families. By comparison, Weatherby (1943) listed 52 species from the much larger area of the State of Coahuila, and Weatherby (*loc. cit.*) and Knobloch (1942) together indicated 68 species from Chihuahua. Eighteen species listed here as occurring in the Monterrey Quadrangle do not occur in Coahuila according to Weatherby's data. For the Cayuga Quadrangle, another square degree (42°–43° N., 76°–77° W.), comparable, but smaller, since it is 17° farther north, I listed (Clausen, 1949) 42 species of ferns belonging to four families. Of ten genera found in the Monterrey Quadrangle, seven occur in the Cayuga Quadrangle, but only two species are common to both areas. These are *Pellaea atropurpurea* and *Polystichum acrostichoides.* Curiously, the plants of these two species in the eastern Sierra Madre and in the northern Appalachians appear to be good matches, not subspecifically separable.

SUMMARY

A survey of the ferns known from the Monterrey Quadrangle (25°–26° N., 100°–101° W.) indicates that at least 47 species occur in that area. This estimate is based on collections made in April, 1949, specimens in the Wiegand Herbarium of Cornell University, and from various published reports. *Pteris vittata* is reported for the first time from northeastern Mexico and the range of *Notholaena neglecta* is extended slightly eastward.

CORNELL UNIVERSITY, *Ithaca, New York*

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The Male-fern in Vermont

HAROLD G. RUGG

The male-fern was first discovered in Vermont by Miss Nancy Darling, of Hartland, in September, 1905. Miss Darling, a school teacher of extraordinary ability, was driving to her home about three miles from Hartland Village when she spied an unusual fern by the roadside. She later identified this as *Dryopteris Filix-mas*, a fern at that time not included in the range of Gray's Manual. Miss Darling owned a copy of Campbell Waters' "Ferns" and found there a brief description of the fern. Waters makes the interesting statement that it is the only fern used in medicine. The nearest stations for the male-fern known were in the Gaspé Peninsula to the north and in northern Michigan to the west. The Hartland colony was a small one consisting only of about six plants. It was my good fortune to visit this station with Miss Darling soon after its discovery and again a few years ago. Growing in a protected place in woods near a stonewall at an elevation of 1400 feet, the fern has increased somewhat.

The next year Miss Mabel Strong, of Woodstock, now Mrs. Mabel Heselton, discovered a colony of the fern in Woodstock, a town adjoining Hartland, a colony of over 100 plants. Other stations were discovered about this time in Bridgewater, a town adjoining Woodstock, by Mrs. Heselton, and on Paine Mountain, in Northfield about 60 miles away, by the late E. J. Winslow. All these stations are over 1200 feet in elevation.

Mrs. Heselton observed that the fern was always found growing in proximity to butternut trees. The first Woodstock station disappeared in a few years. Cattle were in the pasture where the fern was found and it was believed that they had cropped the plants sufficiently to kill them. Others began hunting for the fern in the Woodstock vicinity and shortly five other Woodstock stations were located, all of which have survived.

The hybrid *D. Filix-mas* × *Goldiana* was found by Mr. Winslow on Paine Mountain, and he also discovered *D. Filix-mas* × *marginalis* at the Bridgewater station in 1910. Here he found another hybrid, *D. Clintoniana* × *marginalis*. On one of my visits to the stations at Woodstock with Mr. Winslow he suggested that the fern might be found on a similar high location some ten miles away in the town of Reading. Accordingly, Mr. Winslow, Mr. J. G. Underwood, and I visited this hill and found a large colony of the fern growing in an open field. The plants were knee-high. This station has unfortunately been lost.

In 1911 Miss F. E. Corne, a member of the Fern Society, discovered a large station of the fern in Barnard, a town adjoining Woodstock. Here, too, she found the hybrid with *marginalis*. The next Vermont station to be recorded was across the Green Mountain range in the town of Brandon. In 1913, Mr. George Kirk of Rutland and Mr. D. Lewis Dutton, of Brandon, found a small station for this fern in a moist cool ravine at an elevation of 1000 feet. Some of the plants in this colony were of the variety *incisum*, as described by Clute. This is the only known station west of the Green Mountains. Another station was discovered by a roadside in Williamstown and a single plant in the town of Calais at the farm home of Miss Sylvia Bliss.

Of all these stations the Hartland one is the only one which has shown an increase in the number of plants. The very large colony on Paine Mountain has practically disappeared. Of the magnificent waist-high plants found by Miss Corne in Barnard only two or three small plants could be found a few years ago. What is the cause for this disappearance? In one Vermont town a large colony of *Dryopteris Goldiana* was entirely destroyed many years ago by an out-of-state nurseryman who collected every single plant for his nursery. But to my knowledge no nurseryman in the East has ever collected nor listed for sale the male-fern. Furthermore, not many people know of the exact locations of the Vermont stations. I discovered a possible answer relating to the disappearance of the fern when, just before World War II, I visited with Mr. Kirk, one of the discoverers, the Brandon station. This station is about half a mile from the main highway. When we reached the spot we could not at first find any plants of the fern. The few plants had all been cropped almost to the ground by cattle. The next year we visited the station again and found the plants in the same condition. In the immediate vicinity were many plants of *Dennstaedtia punctilobula*, *Dryopteris spinulosa* var. *intermedia*, and *Dryopteris spinulosa* var. *americana*. Yet none of the fronds of these had been touched by cattle. I feared the station would be destroyed entirely. Mr. Kirk and I were delighted, however, when visiting the station two years ago to find no cattle in the large pasture, and the plants still alive but not as big as formerly. The fronds were rather short. There is a possibility that the large luxuriant plants in the Barnard and Northfield stations had been cropped by cattle until finally they were killed. Or possibly deer were the guilty culprits. Deer are abundant in Vermont and I have seen many plants of *Cypripedium hirsutum* eaten by them.

The North Bridgewater station, too, has unfortunately decreased in size but not from the same cause. This station is in a remote, country district half a mile or more from any habitation. The fern grows on both sides of a narrow highway. On one side of the road is a bank, and one the other formerly a ditch. As this station is only about twenty-five miles from Hanover I have often visited it and have taken members of the American Fern Society, three of them coming from as far away as Pennsylvania. It is always a pleasure to drive slowly along the road and let the visitor spot the fern from the car. On a visit a few years ago to this station with Mr. Richard Harlow, the most enthusiastic fern student it has been my good fortune to meet, we were greatly disturbed to find that half of the colony had been destroyed. The town fathers had decided to widen the narrow, almost one-way country road. The ditch where the most vigorous plants of the fern had been found had been filled with boulders and gravel so that many of the plants were covered with two feet of soil. Fortunately about seventy-five plants still remain including a few of the hybrid. As the male fern was reported from Maine a few years ago we may hope that other stations may be found in the East. Undoubtedly the Woodstock area should be explored more carefully. The mystery of plant distribution is indeed a baffling one.

DARTMOUTH COLLEGE.

Ferns of Pico Bolivar and the Sources of the Venezuelan Flora

JOSEPH EWAN

"The possibility of seeing Condors and Harpy Eagles in their native haunts, and being able to collect alpine seeds in a 'little-worked' locality" was one naturalist's filip for his ascent of the highest peak of Venezuela, Pico Bolívar. Dr. E. M. Chenery, the naturalist just quoted, who ascended Pico Bolívar a decade ago, has written briefly of his trip. His expedition, he writes, was but the second party of *extranjeros* to ascend the peak which lies just to the south of the four-century-old city of Mérida on the Pan American Highway. Pico Bolívar is the highest summit of the Sierra Nevada de Mérida, rising to an imposing 16,400 feet, and, together with the nearby Humboldt Peak and lesser peaks of the Columna massif, creates the backdrop of the beautifully situated city.

It will be evident from a glance at the map of the vegetation of Venezuela published by Pittier and Williams (1945, 103) that the Andes of Mérida represent the northernmost extension of the páramos of the northern Andes. This map may be advantageously matched with that of Vergara of 1906, the páramo detail of which has been reproduced by Pennell (1938, 428). The Vergara map shows the relationship of this northern extremity of the Andes to the páramos of Colombia; indeed, the Venezuelan area, designated on the Vergara map as the Sierra Nevada de Mérida, suggests one of the several islands of páramo stretching archipelago-like in a northeast-southwest trend.

Having previously explored for ferns and seed-plants on several of the volcanic peaks of southern Colombia and on Pichincha, above Quito, Ecuador, I was particu-

ABOVE: PICO BOLÍVAR AS SEEN FROM [illegible] TO TORO PASS, ABOVE MERIDA (PHOTOGRAPH BY JOHN BEARD)
BELOW: DR. JOHN BEARD AMONG FRAILEJONES ON PICO BOLIVAR

larly interested in comparing the vegetation of the granitic (i.e. non-volcanic) Andes of Mérida with that of the more southern volcanic summits. It was fortunate, then, that I should meet Dr. and Mrs. John Beard, then residents of Trinidad, B. W. I., in Mérida on a kind of busman's holiday from their botanical labors. They were completing arrangements with the local guide and *arrieros* for an ascent of the peak and kindly invited me to join them. Opportunity for botanizing was somewhat restricted by the fact that we were obliged to return to Mérida promptly and collections had to be limited, therefore, to plants and ferns of special interest. Since I intended to make a special study of the fern flora of the peak, I made an effort to collect specimens of all Pteridophyta encountered. Some of these collections are now in the National Herbarium at Caracas and have not been available for the preparation of this paper. A set of all numbers returned to the United States is represented in the Herbarium of the U. S. National Arboretum and at least fragments are in my personal collection on deposit at Tulane University.

Though Pico Bolívar appears conical when seen in a photograph of the peak itself, it is in fact but an eminence on a long high crest separating the *llanos* of the upper Orinoco from the agricultural mountain valley of which Mérida is the principal city. The extensive igneous rock exposures of the Sierra Nevada de Mérida are unusual among the northern Andes which are characteristically of either metamorphic or sedimentary composition. This great Sierra Nevada de Mérida must harbor many interesting ferns, which will continue to be brought in at an ever accelerating rate with the modern ease of air travel and relative accessibility of Mérida from Caracas. Trails are few, and though it is not hazardous to leave the trails at many points, particularly after passing the *paramillo* or the upper limit of the fog forest, the natives thoroughly disapprove of proceeding far upon an unknown trail or away from ancient paths. They have small appetite for exploration and no zest for fern records! In fact they commonly assume what we would identify as psychosomatic illnesses. This results no doubt from a combination of a dread of the unknown, often deep poverty with its attendant lack of adequate clothing and nutritious diet, and a fundamental indifference to the success of the enterprise. These human considerations must always create the backgrounds for botanical exploration in the tropics, for there guides and porters are indispensable in the carrying out of expeditions, short or long, and few, indeed, are the natives who are qualified or who wish to venture on such an exploration as the ascent of Pico Bolívar.

Sallies into the Andes of Mérida have been made in the past by Alfredo Jahn of Caracas, A. H. G. Alston of the British Museum, South Kensington, and E. M. Chenery, chemist and naturalist of Trinidad (cf. his paper of 1939). Jahn and Alston have on different occasions collected the ferns along with flowering plants; Chenery, seeds of the alpines that might be induced to grow in English gardens. The itineraries of the earlier botanical explorers of the Nineteenth Century insofar as the Andes of Mérida are concerned are unknown. We know that Karl Moritz (1797–1866)[1] collected plants in the vicinity of Mérida very energetically between 1835 and 1837, Nicholas Funck (1816–1896) and Louis Joseph Schlim less extensively in 1845, preceded the year before by another collector under Belgian auspices, Jean Jules Linden (1817–1898). In the early 1850's Hermann Karsten

[1] Karl Moritz, born in the Province of Saxony, studied theology and later became Hauslehrer. He collected plants in the West Indies, 1834–35, and in Venezuela, 1835–37, from the northern parts of the country to the Orinoco and Apure rivers. He collected many ferns about Mérida and many of these were described by Klotzsch and others. Biographical notes on Moritz, and other collectors mentioned, may be found in Pittier, 1926, 3 *et seq.;* Knuth, 1926, 739, and Röhl, 1943.

(1817–1908) travelled through Mérida en route to Colombia and paused to collect in the Sierra Nevada there. But for none of these do we have anything more than the most general idea of their areas of collecting.

No enumeration of the ferns of the Andes of Mérida has been published, but reference to the comprehensive flora of Venezuela by Knuth (1926) reveals 104 Pteridophyta credited to the general region, judging from the collections cited therein which are either specifically reported from the range or credited to "Mérida" and indubitably taken in the Sierra Nevada above the city. British Guiana has 298 Pteridophyta, of which 24 species are endemic, while the three Guianas, British, French and Dutch, taken together, possess 354 species according to Posthumus (1928). Comparisons of these figures with the 104 species reported from the Andes of Mérida must not be made until more complete studies of the distribution patterns of each species are known. However, suggestions may be made as to the origins and history of the fern flora of the Andes of Mérida from these incomplete data. Later in this paper the sources of the Venezuelan flora are considered and the history of the Pico Bolívar ferns may be posed against this consideration of the sources of the larger geographic area.

FERNS OF PICO BOLÍVAR

Of the 104 Pteridophyta reported from the general "Mérida" region, I personally collected only nine species on our ascent of Pico Bolívar, and made notes on three additional species (e.g. *Blechnum* sp.) which I judged to be conspecific with those previously collected in northern Colombia.

Certainly the most interesting fern genus in the Andes of Mérida is *Jamesonia*. Three species of *Jamesonia*[2]

[2] *Jamesonia* commemorates a "botanical worthy," correspondent of W. J. Hooker, and long time resident botanist of Quito, William Jameson (1796–1873).

are reported from the range by Kunth, viz., *J. nivea, scalaris* and *canescens.* I found *Jamesonia canescens* rather frequent locally in a narrow altitudinal zone of from 13,500 to 14,000 feet on my ascent of the peak. It was associated with a species of *frailejon* (*Espeletia spicata* Sch. Bip.), a tree composite with pale or whitish woolly leaves and racemes of woolly flower-heads borne in the axils of the close-set leaves, an habitat photograph of which is shown in *Plate 11.* The genus *Jamesonia,* numbering some eighteen or more species ranging from Chiapas and Costa Rica to Peru, is characterized by indefinite apical growth; the close-set pinnae spread horizontally above each other to recall to mind the coils of a spring or again the interlocking teeth of a zipper. *Jamesonia canescens* is rufous, especially when young, from the great number of long hairs investing the pinnae, a character not uncommon in several species of this high-altitude genus. A second species of *Jamesonia,* of stiff very erect habit, the fronds growing in close tufts in grassy sites, was found at lower elevations on Pico Bolívar, at from 10,000 to 11,000 feet. This second *Jamesonia,* which seems to agree with specimens examined in Caracas of an undescribed species given a manuscript name commemorating Alfredo Jahn by Maxon, was associated with another *frailejon* (*Espeletia* sp., *Ewan* 16,981).

Another genus of interest to me, for I had previously collected members of the group in southern Colombia and Ecuador, was *Polystichum.* This represents that section of *Polystichum* centering about "*Polystichum pycnolepis*" as that name appears to be used in collections examined at the national herbaria at Caracas and Bogotá. This group of Polystichums, certainly related to the widespread *P. aculeatum,* occurs at high elevations in the Andes, generally as small tufts beneath rock outcrops on the *páramos,* as illustrated by *Plate 12.*

Polystichum pycnolepis on Pico Bolívar

Throughout the northern Andes *the* epiphytic genus of the cloud forests, where ferns are both abundant and diversified, is *Elaphoglossum* with 18 species in the Andes of Mérida. Along with *Polypodium,* with 26 species in the region, *Elaphoglossum* forms colonies of crowded fronds on the horizontal branches of trees large and small, as well as upon the mossy trunks themselves. Many times it is difficult to find fertile fronds of these Elaphoglossums and evidently many years may pass without soriferous fronds being produced. *Elaphoglossum Bellermannianum* (Klotzsch) Moore, not reported by Knuth for the region, was collected near Paso del Toro, at 13,000 feet on the trail to the summit of Pico Bolívar, where it was rare on an open talus slope in full sun—a variation from the usual epiphytic habitat of the genus. It was associated with the more frequent *Elaphoglossum Matthewsii,* previously reported from the Mérida region by Knuth.

Elaphoglossum, along with *Jamesonia* and some other ferns of the higher cloud forests and páramo, exhibits an adaptation, in the opinion of Theodor Holm (1900, 159), against extreme changes of temperature and the drying effects of winds in the form of a dense covering of fimbriate scales or, in the instance of *Jamesonia,* long curling hairs upon generally both surfaces of the pinnae. The existence of comparable adaptations in such phanerogamous genera as *Plantago, Lupinus,* and *Espeletia* (cf. Heilborn, 1925, 164) occurring on the Andean páramos suggests the existence of what the plant geographer recognizes as epharmonic convergence of growth forms.

Of the familiar north temperate genus *Lycopodium,* eight species are reported from the Andes of Mérida by Knuth, to which may be added a ninth, *Lycopodium complanatum* var. *tropicum,* which I found frequent along the borders of the páramillo at elevations of from 7000 to 9000 feet, growing in both full sun and partial shade. This *Lycopodium* belongs to the group of nearctic species to be noticed in the Venezuelan flora, discussed later in this paper. Chenery remarks on the presence of *Lycopodium clavatum* on Pico Bolívar as a "clue" to the "nature of the soil in the locality, which must have been extremely acidic to have supported a clubmoss." He made detailed soil profile samplings on the peak but these results have not been published to my knowledge. He characterizes the páramo soil as very porous and well drained, "with a highly humic, black top-soil and lime-free subsoil."

SOURCES OF THE VENEZUELAN FLORA

The Venezuelan flora of today is composed of seven elements, viz., a *nearctic*, an *Antillean*, a *Granadan*, an *antarctic*, an *Amazonian*, an *Afro-American*, and an *endemic* autochthonous element, that vary in their concentrations among the four vegetational regions of the country. The seven floristic sources of the flora are suggested by a study of several phanerogamous genera of Venezuela as well as by an inspection of its fern flora. Each of these seven floristic components will now be briefly discussed and their representation in the Pico Bolívar region indicated.

First, the nearctic element is the North American facies of the widely distributed and generally recognized holarctic pre-Pleistocene flora of the North Temperate Zone around the globe. The nearctic group of species which is most extensive in the cordilleras of Western North America diminishes southward, being represented weakly in Mexico and Central America though some species reach as far south as the Andes of Venezuela, Colombia, Ecuador, and Peru. Such genera as

Hypericum, Geranium, Potentilla, Malvastrum, Hypochaeris, Gentiana and *Lupinus* in the northern Andes testify to the presence of this nearctic component, and many of these genera are familiar in the Pico Bolívar region. The genera *Woodsia,* represented in our region by *Woodsia crenata*, and *Cystopteris,* by the global *Cystopteris fragilis* studied so comprehensively by C. A. Weatherby, are ferns of this nearctic assemblage. On the species level *Lycopodium complanatum, L. clavatum,* and *L. alopecuroides* represent this first group.

The Antillean element may be related historically to continental South America. Indeed the West Indian flora has been suggested as representing a northern extention of the South American flora, now fragmented into remnant groups of genera and species showing diminishing kinship with the mainland as one passes from island to island through the Antilles. Trinidad and Tobago, for example, show strong affinities to the continent of South America in their floras, with many genera failing to pass farther north than these adjacent islands of Venezuela. Complications arise, to be sure, with this distribution effect in the Greater Antilles, where the larger land masses, the former land connections with the mainland of Central America to the west, and the sedimentary composition of the rocks as compared with the volcanism of the Lesser Antilles all add to the complexity of an attempted floristic analysis. *Bouvardia, Guaiacum, Hura,* and *Crescentia* are better known genera of the Antillean group among the flowering plants; *Ormoloma, Rhipidopteris, Anetium, Hecistopteris,* and *Paltonium,* among the ferns.

In 1867 Adolf Ernst directed attention to the botanical affinity between the Gulf Coast of the United States and Venezuela exclusive of the intervening islands. It would be useful to reinvestigate Ernst's work in the light of our modern knowledge of these floras.

Thirdly, the Granadan element is a coherent rather sharply defined group of genera and species ranging from the Andes of Venezuela, with many reaching the Pico Bolívar country, south to the three chains of the Andes of Colombia, and extending more or less continuously southward into Ecuador or persisting only in the eastern cordillera of that country as far as Loja. This Granadan element is rich in peculiar and distinctive genera. It is particularly well developed in Colombia proper with mere northern extensions into the Venezuelan Andes, as for example in the scrophulariaceous genus *Aragoa*, comprising five species with one reaching the Sierra Nevada de Mérida (Pennell, 1938). Occasionally genera may reach as far south as the Bolivian Yungas or northward to Costa Rica, but the concentration of these genera peculiar to the tropical Andes is in Colombia, where they may reach the western cordillera and central cordillera or exist only in the eastern chain with endemic species known from each division of the Colombian Andes. Characteristic Granadan genera, most of which extend into the Venezuelan Andes, include *Cinchona, Escallonia, Macrocarpaea, Symbolanthus, Desfontainea, Befaria, Aragoa,* and *Espeletia.* Among ferns the genera *Jamesonia* and *Loxsomopsis* are Granadan, the former being well represented in the Sierra Nevada de Mérida. There is some evidence that this Granadan floristic component is ancient in the history of the South American flora. Certain arboreal growth forms commonly associated with the older floras of oceanic islands and ancient continental land masses, appear in the genera *Espeletia* and *Senecio* in the northern Andes. This Granadan pattern of distribution is, moreover, found down to levels *below* the rank of species. For example, the fern *Doryopteris pedata* consists of three varieties, according to Tryon (1944, 470), distributed as follows: var. *typica* is West Indian in its distribution—a good example of an Antillean floristic member as outlined in this paper; var. *multipartita* is subtropical South American, ranging to the south of the Amazon Basin, and var. *palmata,* apart from a few northern outlying localities in Central America, is northern Andean—a typical Granadan element.

The Antarctic floristic element is of great interest to the plant geographer for its suggestion of early migration paths from an antarctic subcontinent.[3] It represents those genera and species having a distribution from southern Chile and Patagonia northward along the main Andean chain to the Venezuelan Andes or infrequently even to Costa Rica. The number of antarctic genera and species diminish noticeably as one follows north from Chile to Peru and Colombia; the suggestion from this fact that a migration northward along the Andes from the southern "tail of the continent" took place in the past is obvious. The presence of the family Proteaceae and of the genus *Podocarpus,* both of which reach as far as the Venezuelan Andes, are striking examples of this antarctic component. Two *Pernettyas,* another genus of antarctic affinities, were noticed on Pico Bolívar by Chenery. It is not generally realized that the genus *Nicotiana,* thought so characteristically neotropical, shares this antarctic pattern! I know of no distinctively antarctic fern genus in the tropical Andes.[4] There are groups of species, however, which demonstrate clear antarctic affinities. Gualterio Looser has pointed out the

[3] John Ball (1818–1889), was perhaps the first botanist to propose the *antarctic* category in the sense used here ("Contributions to the Flora of the Peruvian Andes, with remarks on the history and origin of the Andean flora," Jour. Linn. Soc. Bot. 22: 15. 1885). However, Ball's use of the term "Andean" therein does not equate to "Granadan" element of the present paper. "Andean" included the highland floras of Central America, portions of which have other origins.

[4] Possibly the Old World genus *Histiopteris* may belong to this antarctic group. It reaches Roraima and its extension into both Chile and Brazil is matched by the antarctic genus *Araucaria.*

relationships of certain Chilean species of *Lycopodium* with those of New Zealand in his discussion of the ferns of Volcán Osorno of southern Chile (1943, 172). These same affinities exist among certain *Lycopodiums* of the tropical Andes as well.

The Amazonian element, the fifth component, comprises those genera having a common concentration of species in the Amazon Basin of Brazil and adjacent cognate regions. Lyman B. Smith has commented (1945, 297) on the uniformity of this Amazonian flora. More often characterized by well-marked species than by genera as a whole, this Amazonian floristic element occasionally appears unexpectedly on the Pacific Coast of Colombia or in the lower valley of the Magdalena River. Many more examples appear in the Venezuelan flora of the Orinoco basin. Though all have extralimital species beyond the Amazon Basin, the following genera belong to this group: *Hevea, Bombax, Bertholletia, Spigelia,* and many genera of palms. Of course none of these plants of the selva and rain forests of the lower slopes are to be found in the Pico Bolívar country of the Andes but are encountered in the Guayana region of Venezuela to the east.

The sixth floristic element, the Afro-American, bears on the problem of Continental Drift, defended by some botanists (cf. Camp, 1939, and Wulff, 1943) and as vigorously opposed by others. It is difficult to arrive at the solution of the problem of the origin of such plant genera as *Chrysobalanus, Hoffmannseggia, Parkinsonia, Sphaeralcea, Vismia,* and *Voyria,* or such animals as the manatee and the lung fishes, all known from both sides of the South Atlantic Ocean, without resort to some such explanation as the separation of the continents. The existence of a submarine ridge in the South Atlantic and of the reciprocal stratification of certain sedimentary rocks on both sides of the ocean in certain points, not to mention the obvious conformity of the continents themselves, all seem to corroborate the theory of Wegener. Then, too, the number of examples of plant genera known from "America and continental Africa only" is impressive. Ronald Good lists 62 genera having this distribution pattern (1947, 356). Among the ferns I find no generic examples of this Afro-American pattern, but *Dryopteris protensa,* a species of tropical America and West Africa, illustrates this Afro-American pattern. The peculiar discontinuous distribution of *Asplenium platyneuron,* known from the southeastern United States and South Africa, has been suggested by me (1945, 121) to be the result of possible stratospheric dispersal of spores around the earth. The number of species of *Asplenium* (e.g., *A. serratum, anisophyllum, formosum, laetum,* and *serra*) exhibiting this distribution pattern, on the other hand, suggests a present relict distribution more ancient in its origins than accidental stratospheric dispersal of spores.

There exists an interesting endemic element in the flora of Venezuela. This endemism is evidently truly autochthonous rather than epibiotic or the remnants of a "lost flora." Two fairly well defined areas of endemism exist in Venezuela, with possibly a third little known province opposite the island of Trinidad. The Andes of the Colombian-Venezuelan border extending from Ocaña to Mérida present a distinct endemic province; the gentianaceous genus *Lagenanthus* and numerous distinctive species occupy this region. It is epicenter for the genus *Espeletia,* of which seven species occur on Pico Bolívar alone. The second region of endemism is the scattered chain of sandstone *cerros* or plateaus lying to the southeast of the Orinoco in what Pittier and Williams designate the Guayana vegetation region. No comprehensive study of the endemism of these cerros has been published, though Steyermark has launched such a survey.

In addition to the well known Duida and Roraima summits of the Pacaraima region of the Venezuelan "Guayana region," there are Ptari-tepui (cf. Steyermark, 1947) and Auyan-tepui (cf. Gleason and Killip, 1939). Recent explorations have now added the Tafelberg and Kaieteur Plateau of Surinam to the east (cf. Maguire, 1948). The fern genera *Hymenophyllopsis, Pterozonium* and *Syngramma* and the angiospermous genera *Heliamphora, Cephalocarpus, Everardia, Tyleria, Raveniopsis, Bonnetia, Ochthocosmus, Tepuia, Blepharodon, Chorisepalum*, etc., distributed among many families, monocot and dicot, primitive and advanced in phylogenetic position in classification, characterize one of the richest endemic floras of the New World. This endemism does not seem to be wholly a more extensive development of the more widespread Andean flora to the west, though there are many affinities among these endemic genera with the Andean flora. The subject is a complex one, and not until a more complete knowledge of the Sierra Perija along the Colombian border, the Santa Marta of Colombia, and the still little known cerros of the coastal plain of the Orinoco lowlands, will it be possible to suggest the possible origins of this endemic flora of the Pacaraima region.

There remains but to comment upon the vegetation regions of Venezuela, as proposed by Pittier and Williams (1945, 104), as distinguished from the floristic provinces. They recognize four regions, viz., Coast Range, Andes, Llanos, and the Guayana. Each of these four vegetation regions may be briefly characterized, along with a comment as to the occurrence of the several floristic elements present in them.

The Caribbean Coastal Plain and the Coast Range support, irregularly, xerophilous forests and *espinar*, a tropical deciduous forest and selva. Antillean and Afro-American floristic elements are prominent in this vegetation. Among the fern genera conspicuous in the Coast Range, many as epiphytes, are *Asplenium* and *Diplazium*, along with *Dryopteris* and the tree fern genus *Alsophila*.

The second vegetational region, the Andes, consists of two types of plant cover: the montaña or mountain rain forest and the páramo or grasslands above the limit of trees. Between the two types of vegetation is the *paramillo*, where grow dwarf trees and giant shrubs laden with leafy liverworts and mosses, ferns, and many epiphytic orchids and small bromeliads. In the mountain rain forest the Granadan element is conspicuous, along with the Antarctic and some Antillean species. In the páramo the nearctic and Granadan elements are particularly prominent.

The llanos contain "true savanna" (in sense of I. M. Johnston and A. C. Smith) and deciduous forests in a patchy vegetational pattern. Here there are representatives of the Amazonian, Afro-American, and Antillean floristic groups along with some endemism among the minor herbaceous members of the vegetation.

The vegetation of the Guayana region consists of several classes as to growth form. The topography is varied and this brings together savanna, selva, montaña, and dwarf summit-fog-forest types in juxtaposition. Floristically, the Guayana includes many Granadan elements; *Dicranopteris revoluta* and *Blechnum Schomburghkii*, for example, reach as far east as Roraima from the main Andean chain. Antillean, Afro-American and Amazonian species add to the spectacular endemic components already mentioned to give a diversified vegetation. Of the seven floristic elements in Venezuela, only the nearctic and the Antarctic groups appear to be negligible in the great sandstone plateaus and rain forests of the Guayana.

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TULANE UNIVERSITY.

A New Interpretation of the Dryopteris clintoniana Group

EDGAR T. WHERRY

It has long been recognized that the fern originally named *Aspidium boottii* by Tuckerman in 1843 is a hybrid between *Dryopteris cristata* and *D. intermedia*. From the former it inherits an oblong outline, from the latter sharply incised margins and glandular epidermal-indusial surfaces. Further indication of its hybrid origin is furnished by its rather marked variation from one clump to another, especially in the position of sori and degree of glandularity.

The taxon first named *Aspidium cristatum* var. *clintonianum* by Eaton in 1867, now widely known as *Dryopteris clintoniana* (Eaton) Dowell, is still more variable, combining in various ways the characters of two rather well-marked members of the genus—*D. cristata* and *D. goldiana;* its duration varies from evergreen to deciduous, the rhizome scales from pale brown to shining black, the frond-outline from narrowly to broadly oblong, the tip from gradually to abruptly acuminate, the basal pinnae from deltoid to undulately oblong, and the sorus-position from supra-medial to subcostular. This variability certainly suggests that it, too, is a hybrid. Its spores are, to be sure, more viable than those of × *D. boottii,* so that it has been able to spread beyond the ranges of its presumed parents, but fertile hybrids are known among other ferns.

Upon accepting the view that the name of the Broad Swamp Fern should be written × *Dryopteris clintoniana,* certain related taxa require consideration. In chronologic sequence these are:

DRYOPTERIS GOLDIANA CELSA Palmer (1899); the epithet *celsa* has been subsequently published in 5 different combinations. The original Log Fern of the Dismal Swamp corresponds to *D. cristata* in duration and frond-tip, but to *D. goldiana* in rhizome-scales, basal pinnae, and sorus-position. In the interpretation of this taxon by Fernald[1] for use in the New Manual, the rhizome scales and basal pinnae are described as closer to those of *D. cristata* var. *Clintoniana.* A winter visit to Claremont Wharf, Surry County, Virginia, disclosed that the member of the group occurring there is unlike *D. goldiana* in being evergreen; but it may be noted that a plant agreeing closely with the original *celsa* in practically all respects, found near Bernharts, Berks County, Pennsylvania, is early and completely deciduous. Evidently in this group of ferns unit characters are inherited independently in all sorts of combinations. The epithet *celsa* is then preferably limited to plants of the hybrid showing, as did the type, a preponderance of characters of the *D. goldiana* parent, and presumably representing back-crosses with the latter. There being no accepted plan for naming hybrids so as to bring out degree of parental relationship, this taxon may be tentatively merely designated × *Dryopteris clintoniana* f. **celsa** (Palmer) Wherry, comb. nov.[2]

[1] Rhodora **49**: 104. 1947.

[2] For place of original publication of the new combinations proposed here see Literature, below.

NEPHRODIUM CRISTATUM var. SLOSSONAE Davenport (1902) was subsequently published in at least 4 different combinations. A coarse-toothed variant, such as occurs sporadically in many ferns of this group, this should be known as ×*Dryopteris clintoniana* f. *slossonae* (Davenport) Broun.[3]

DRYOPTERIS CLINTONIANA×GOLDIANA Dowell (1908) is the equivalent of *celsa*.

DRYOPTERIS CRISTATA × GOLDIANA Benedict (1909) is the equivalent of *clintoniana* according to the views here put forward.

DRYOPTERIS CLINTONIANA var. AUSTRALIS Wherry (1937). The supra-medial position of the sori of this taxon suggest that it represents a back-cross with the *cristata* parent. It may therefore be named: ×*Dryopteris clintoniana* f. **australis** Wherry, stat. nov.

DRYOPTERIS ATROPALUSTRIS Small (1938). Differing from the next-preceding essentially only in having shorter and broader frond-outline, this deserves the status: ×*Dryopteris clintoniana* f. **atropalustris** (Small) Wherry, stat. nov.

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The literature references for the taxa here included are given in Broun's Index to North American Ferns (1938). Only those concerned in new combinations are repeated here.

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Dryopteris atropalustris Small, Ferns SE. States, 274. 1938.

UNIVERSITY OF PENNSYLVANIA.

[3] Broun, Index No. Amer. Ferns attributes this combination to Burnham, Amer. Fern Journ. 6: 103. 1916, but Burnham made the combination *D. clintoniana* var. *slossonae*.

A List of the Ferns of Idaho

SEVILLE FLOWERS

The present enumeration of the ferns of Idaho has been compiled mainly from the collections in the herbaria of the following institutions, designated in the list by the appended abbreviations: University of Idaho (I), University of Idaho, Southern Branch (ISB), University of Washington (W), Washington State College (WS), Oregon State College (OS), and Utah State Agricultural College, Intermountain Herbarium (IH). Additional citations, taken from literature, refer to collections in the Missouri Botanical Garden (M), Gray Herbarium (G), New York Botanical Garden (NY), Academy of Sciences, Philadelphia (Ph), and the United States National Herbarium (US). The extensive collections of C. L. Hitchcock and C. V. Muhlick under the label "Flora of Idaho" are cited as H. & M. Numbers in parentheses refer to items cited in the bibliography. The collections are grouped by counties.

BOTRYCHIUM LUNARIA (L.) Swartz. CUSTER: Meadowland south of Stanley Lake, *H. & M.* 9675 (IH, W, WS); Bonanza, *Macbride & Payson* (G) (3).

BOTRYCHIUM MATRICARIAEFOLIUM A. Br. BOUNDARY: Upper Priest River, *Epling* 7457 (US) (3).

BOTRYCHIUM SILAIFOLIUM var. COULTERI (Underw.) Jepson. BLAINE: Redfish Lake, *Henderson* 3715 (US) (3). BONNER: Priest Lake, *MacDougal* 234 (NY) (3). IDAHO: Lolo Trail, Bitterroot Mountains, *Piper* (WS). LATAH: Moscow, *Henderson* (US) (3).

BOTRYCHIUM SIMPLEX Hitchc. BLAINE: Meadow near head of Alpine Creek, above Alturas Lake, 9000 feet, *Cronquist* 3720 (IH).

BOTRYCHIUM VIRGINIANUM (L.) Swartz. BLAINE: Easley Forest Camp, Sawtooth National Forest, 6500 feet, *Thompson* 9923 (W). BONNER: Priest Lake, *Piper* (WS); Lakeview, southern end of Lake Pend d'Oreille, *Sandberg et al.* 762 (G, Ph, US) (3). BOUNDARY: Saddle, Hughes Fork Trail from Lime Creek, *Warren* 321 (WS). IDAHO: Clearwater, *Shattuck & Fenn* (I).

Var. EUROPAEUM Angstr. BONNER: Upper Priest Lake, *Epling* 7175 (M) (3); West Fork of Priest River, *Leiberg* 2812 (US) (3).

WOODSIA OREGANA D. C. Eaton. ADA: 10 miles east of Boise, *Davis* 956 (ISB). ADAMS: Evergreen Camp, *Davis* (ISB). BLAINE: Alpine slope, Sawtooth Range, 8000 feet, *Thompson* 13551 (W, WS). BONNER: Mount Hope, *Dunkle* 1391 (I). BUTTE: Basalt reef at Martin, 5700 feet, *Cronquist* 2385 (ISB). CUSTER: East Fork of Stanley Lake Creek, *Worley & Mann* 36–162 (11). FREMONT: North of St. Anthony, *Davis* 711 (ISB). IDAHO: Freedom, *Davis* 956, 1919 (ISB). LEMHI: About 10 miles south of Gibbonsville, *H. & M.* 9062 (W, WS); Eight-mile Canyon, 3 miles west of Leadore, *H. & M.* 9291 (W). NEZ PERCE: Lewiston Hill, Lewiston, 1800 feet, *Hitchcock & Samuel* 2516 (W).

Forma GLANDULOSA Taylor. CUSTER: About 15 miles south of Dickey, along North Fork of Big Lost River, *Hitchcock* 15576 (WS).

WOODSIA SCOPULINA D. C. Eaton. BLAINE: Alpine slopes, Sawtooth Range, 8000 feet, *Thompson* 13571 (W); 9 miles north of Ketchum, *Cronquist* 5202 (ISB); west side of Alturas Lake, 7300 feet, *Cronquist* 2608 (ISB). BONNER: Mount Hope, *Dunkle* 1390, 1391 (I); Lake Pend d'Oreille, *Dunkle* 1160 (I). CLARK: Beaver Creek, Spencer, *Cronquist* 858 (ISB). CUSTER: Across river from Challis, *H. & M.* 8945 (W, WS); among boulders, Sunbeam, *H. & M.* 14107 (W, WS); in canyon about 10 miles west of Challis, *H. & M.* 9543 (W); vicinity of Stanley Lake, *H. & M.* 9623 (W); Big Creek, northeast of Patterson, 7000 feet, *Hitchcock et al.* 3759 (W); slopes near Stanley Lake, 7500 feet, *Thompson* 14053 (W); top of ridge between east and west forks of Stanley Lake Creek, 8000 feet, *Worley & Mann* 36–169 (11). KOOTENAI: Lone Mountain, 2 miles north of Ramsey, *Sister Mary Milburge* 891 (W); Mount Hudlow, near Rathdrum, *Sister Mary Milburge* 1050, 1080 (W); Coeur d'Alene, *Sister Mary Milburge* 1115 (W); Rathdrum, *Ash* (I). LEMHI: Shoupe, *Davis* 416 (ISB). SHOSHONE: South slope of Little Baldy Lookout, *Witt* 1059 (W). VALLEY: Payette Lake, *Davis* 916 (ISB).

CYSTOPTERIS FRAGILIS (L.) Bernh. BEAR LAKE: Bloomington, *Davis* 1642 (ISB, WS). BOISE: Lowman, Atlanta Road, *H. & M.* 10046 (W, WS); Bull Trout Creek, west of Stanley, *Cronquist* 3624 (W, WS). BONNER: Clark's Fork, 15 miles west of Sandpoint, *Hitchcock* 2900 (WS); Lake Pend d'Oreille, *Dunkle* 465

(I); Warren Island, *Dunkle* 1164, 1165 (I); Trestle Creek, *Dunkle* 1396, 1410 (I). BUTTE: Lost River Mountains, north of Leslie, 6500 feet, *H. & M.* 8856 (W). CLARK: 5 miles east of Kilgore, *Cronquist* 1217 (ISB). CUSTER: 10 miles west of Challis, *H. & M.* 9527; Ryan Peak, Boulder Mountains, *H. & M.* 10587 (W, WS); Lost River Mountains, base of Mount Borah, *H. & M.* 10944 (W); 25 miles southwest of Chilly, *Cronquist* 3328 (ISB. ELMORE: Upper Trinity Lake, *H. & M.* 10368 (W, WS). IDAHO: Opposite Kamiah, *Meyer* 921 (W, WS); Lochsa River, *Rose* 521 (WS); above Selway Falls, *Constance & Rollins* 1633 (WS); mountain trail above Lochsa River, at Pete King Creek, *Constance & Rollins* 1679 (WS); White Sand Lake, *Shattuck & Fenn* (I), *St. John & Mullen* 8412 (WS); Sheep Creek, 1 mile from Snake River, *Packard* 538 (WS); Red River Ranger Station, *Davis* 3329 (ISB, WS); Selway River, *Davis* 3745 (ISB). KOOTENAI: Post Falls, *St. John et al.* 4302 (WS); Mount Hudlow, *Sister Mary Milburge* 1073, 1078 (WS); Rathdrum, *Ash* (I). LATAH: Thatuma Hills, *Dillon* 576 (W, WS); Moscow Mountain, *Hunter* (WS), *Piper* (WS). LEMHI: Salmon River, below Shoupe, *Davis* 120–36 (ISB). OWYHEE: Silver City, *Macbride* 945 (ISB); east of Bruneau, *Macbride* (ISB).

POLYPODIUM HESPERIUM Maxon. KOOTENAI: Coeur d'Alene, *Sister Mary Milburge* 1075 (WS). NEZ PERCE: Clearwater Canyon, 4.8 miles east of Leadore, 9000 feet, *Cook* (WS). SHOSHONE: Tick Creek Falls, *Moore* 413 (WS).

PHEGOPTERIS DRYOPTERIS (L.) Fée. BENEWAH: St. Maries Valley, *Wells* (I). BONNER: Trestle Creek, *Dunkle* (I); Hope, Strong Creek, *Dunkle* 1120 (I). BOUNDARY: Lime Creek, *Warren* 364 (WS); Kaniksu Forest, *Redding* 149 (WS), *Witham* (WS). CLEARWATER: Little North Fork, Clearwater River, *Pickett* 1130, 1131 (W, WS), *Davis* (ISB). IDAHO: Lochsa Valley, *Barkley* 1796 (W). KOOTENAI: *Sandberg* (WS). LATAH: Moscow Mountain, *Hunter* 77, 78 (I), *Aldrich* (I); Grizzel Camp, Palouse Region, *Newton* (WS); Viola Mountains, Flannigan Creek, *Piper* 1735 (WS), *Ferris & Duthie* 1378 (WS). SHOSHONE: Tick Creek Canyon, above falls, *Moore* 415 (WS); vicinity of Little Baldy Lookout, *Will* 1035 (WS).

DRYOPTERIS DILATATA (Hoffm.) A. Gray. BENEWAH: Alder Creek, *St. John & Jones* 5390 (WS). BONNER: Lightning Creek, north of Clark's Fork, *Christ* 154 (WS). BOUNDARY: Lime Creek, *Warren* 318 (WS). CLEARWATER: Elk River, *Aldrich* (I), *Davis* (ISB).

DRYOPTERIS CRISTATA (L.) A. Gray. CLEARWATER: Headquarters, *Davis* (ISB).

DRYOPTERIS FILIX-MAS (L.) Schott. BOUNDARY: Hughes Fork Trail from Lime Creek, *Warren* 320 (WS). IDAHO: Sheep Creek, off Snake River Canyon, *Packard* 539, 543 (WS); Deep Creek, at Snake River Canyon, 2600 feet, *Perkins* 91 (WS); Lochsa Valley, *Barkley* 1789 (W); Lochsa River, *Rose* 522 (W, WS). SHOSHONE: Jug Lookout Station, *Wilson* 347 (ISB).

DRYOPTERIS INTERMEDIA (Muhl.) A. Gray. BANNOCK: City Creek, *Davis* (ISB). IDAHO: Lowell, *Shattuck & Fenn* (I).

DRYOPTERIS SPINULOSA (O. F. Müll.) Watt. CLEARWATER: Little North Fork, Clearwater River, *Pickett* 133 (WS).

POLYSTICHUM ANDERSONI Hopkins. BOUNDARY: Lime Creek, *Warren* 316 (WS); Hughes Fork, *Warren* 317 (WS).

POLYSTICHUM LONCHITIS (L.) Roth. BOUNDARY: Saddle, Hughes Fork Trail from Lime Creek, *Warren* 363 (WS). CUSTER: Near Stanley Lake, Sawtooth Mountains, 8500 feet, *Thompson* 14039 (W); creek emptying from the west in Stanley Lake Creek about 4 miles above its junction with lake, *Worley & Mann* 36–183 (11). IDAHO: He Devil, Seven Devils Mountains, 9100 feet, *St. John & Mullen* 8541 (WS). KOOTENAI: *Sandberg* (WS). LATAH: Moscow Mountain, *Thomas* (I). SHOSHONE: Freezeout Saddle, *Wilson* 283 (WS).

POLYSTICHUM MUNITUM (Kaulf.) Presl. BENEWAH: Benewah, *St. John & Jones* 5398 (WS); fork of St. Marys River, *Leiberg* 1147 (W). BONNER: Newport Trail, *Witham* 80 (WS); Hope, *Dunkle* 1121 (I). CLEARWATER: Ahsahka, *Pickett* 588 (W, WS); Little North Fork, Clearwater River, *Pickett* 1128 (W, WS). IDAHO: Powell Ranger Station, *Davis* (ISB, WS); Moose Creek Trail, *Kirkwood & Severy* 1695 (US); North Fork, Clearwater River, *Epling & Houck* 9424 (US). KOOTENAI: *Sandberg* (WS); Chatcolet, *Cozier* (WS).

POLYSTICHUM SCOPULINUM (D. C. Eaton) Maxon. IDAHO: Dry Diggins, Seven Devils Mountains, *Packard* 428 (WS). VALLEY: Gold Fork Lookout, Sawtooth Mountains, *Thompson* 13797 (W).

POLYSTICHUM LEMMONI Underw. Cited for Idaho in Broun's Index to North American Ferns (p. 147).

ATHYRIUM FILIX-FEMINA (L.) Roth. BONNER: Trestle Creek, *Dunkle* 1407, 1409 (I); Priest River, *Hitchcock* 2901 (ISB, OS, W, WS); Hope, *Davis* 3894 (ISB). BOUNDARY: Lime Creek, *War-*

ren 319 (WS). CLEARWATER: Woods above Ahsahka, *Pickett* 587 (WS); Lowell, *Shattuck & Fenn* (I). ELMORE: 3.5 miles north of Rocky Bar, *H. & M.* 10299 (W, WS); Boise River, above Atlanta, *H. & M.* 10110 (W). IDAHO: Lochsa River, *Rose* 323, 525 (WS); Indian Hill, *Davis* 3485 (ISB, WS); Seven Devils Mountains, *St. John & Mullen* 8624 (WS); Lochsa Valley, *Barkley* 1788 (WS); Papoose Creek, *Davis* 2395 (ISB); Warren Summit, *Davis* 2554 (ISB). KOOTENAI: *Sandberg* (WS). LATAH: Moscow Mountain, *Beattie* 977 (WS); Thatuma Hills, *Epling & Houck* 9066 (OS). SHOSHONE: Vicinity of Little Baldy, *Witt* 1089 (WS). VALLEY: McCall, *Davis* 988 (ISB); Green Tables Forest Camp, *Thompson* 13838 (W).

Var. CALIFORNICUM Butters. BANNOCK: City Creek, *Davis* 1549 (ISB, WS). BOISE: Pinehurst, *Macbride* 1641 (W). KOOTENAI: Chatcolet, *Cozier* (WS). LATAH: *Piper* (WS); Moscow Mountain, *Gail* (I). SHOSHONE: Jug Camp, vicinity of Moses Peak, *Wilson* 336 (ISB, WS). VALLEY: Smith's Ferry, *Tucker* 457 (I, ISB).

Var. SITCHENSE Rupr. CUSTER: West side of Redfish Lake, *Worley & Mann* 36–246 (11).

ATHYRIUM AMERICANUM (Butters) Maxon. BLAINE: Divide between Alpine Creek and Twin Lakes, 10000 feet, *H. & M.* 10503 (W); lake near head of Alpine Creek, above Alturas Lake, 9000 feet, *Cronquist* 3743 (ISB, W). CUSTER: Alpine meadow 3 miles south of Stanley Lake, *Worley & Mann* 36–204 (11). ELMORE: Headwaters of Middle Fork of Boise River, above Atlanta, *H. & M.* 10080 (W, WS). IDAHO: Buffalo Hump, west of Orogrande, *Christ* 11622 (ISB); Heaven's Gate, Seven Devils Mountains, *Christ* 12551 (ISB); He Devil, Seven Devils Mountains, *St. John & Mullen* 8548 (WS). SHOSHONE: North slope, Freezeout Saddle, *Wilson* 268 (WS).

ASPLENIUM VIRIDE Huds. Cited for Idaho in Coulter and Nelson, New Manual of Rocky Mountain Botany.

PITYROGRAMMA TRIANGULARIS (Kaulf.) Maxon. IDAHO: Big Canyon Creek, Snake River Canyon, *Skillin & Warren* 740 (10).

LOMARIA SPICANT (L.) Desv. KOOTENAI: Rathdrum, *Ash* (I).

PTERIDIUM AQUILINIUM var. PUBESCENS Underw. BANNOCK: City Creek, *Davis* 1557 (ISB). BONNER: Pack River, *Davis* 3851 (ISB). CASSIA: Howell's Canyon, *Davis* 1384 (ISB). ELMORE: Trinity, *Macbride* 599 (WS). FREMONT: Henry's Fork, Snake River, above Grand View Point, *Cronquist* 1652 (ISB). IDAHO: South Fork, Salmon River, *Davis* 2595 (ISB); 2 miles below Lowell, *Davis* 3517 (ISB, WS); Lochsa Valley, west of Lolo Pass, *Barkley* 1795 (W). KOOTENAI: Carlin Bay, Lake Coeur d'Alene, *St. John et al.* 4253 (WS). VALLEY: Smith's Ferry, *Tucker* 458 (I, ISB). WASHINGTON: Spring Creek, *Davis* 2216 (ISB).

ADIANTUM PEDATUM L. IDAHO: Lochsa River, *Rose* 496, 518 (W, WS).

Var. ALEUTICUM Rupr. BOISE: North Fork, Boise River, *Grandjean* 495 (OS). CLEARWATER: Little North Fork, Clearwater River, *Pickett* 1129 (W, WS). IDAHO: Lochsa Valley, *Barkley* (W); Meadow Creek, above Selway Falls, *Constance & Rollins* 1657 (W, WS); Sheep Creek Lake, at foot of He Devil Mountain, *Packard* 309 (WS); He Devil, Seven Devils Mountains, *St. John & Mullen* 8563 (WS); South Fork, Clearwater River, *Davis* 3403 (ISB, WS); 2 miles below Lowell, *Davis* 3507 (ISB). SHOSHONE: 4 miles above Avery, on North Fork, St. Joe's River, *Wilson* 139 (ISB, WS).

CRYPTOGRAMMA ACROSTICHOIDES R. Br. BLAINE: Alpine Creek, northwest of Alturas Lake, *H. & M.* 10500 (W, WS); above west edge of Alturas Lake, *Cronquist* 2611 (ISB). BOISE: Headwaters of South Fork, Payette River, above Sacajawea Hot Spring, mountain east of Elk Lake, *H. & M.* 9809 (W). BONNER: Priest Lake, Plowboy Mountain, *Hungate* (WS); Priest Lake, *Piper* 6066 (W). CASSIA: Mount Harrison, *Davis* 1374 (ISB). CLEARWATER: Coolwater Ranger Station, *Gail & Long* (I). CUSTER: Lemhi Range, western slope of Mount Mogg, *H. & M.* 11256 (W, WS); on peak 2.3 miles southwest of Stanley Lake, *H. & M.* 9623a (W); talus slope near Stanley Lake, *Thompson* 14043 (W); Mount Hyndman, *Davis* 1683 (ISB); near Boulder Lake, 25 miles southwest of Chilly, *Cronquist* 3399 (ISB); along Marsh Creek, 1 mile below Lolo Creek, 25 miles northwest of Stanley, *Cronquist* 2842 (ISB). ELMORE: 1 mile southwest of Lower Spangle Lake, Middle Fork, Boise River, above Atlanta, *H. & M.* 10146 (W, WS). FREMONT: Talus slope near base of north side of Mount Jefferson, *Cronquist* 1854 (ISB). IDAHO: Seven Devils Mountains, *Packard* 458 (WS); McGaffee's Cow Camp, at head of Squaw Creek, Seven Devils Mountains, *St. John & Mullen* 8387 (WS); Clearwater, *Shattuck & Fenn* (I). KOOTENAI: *Sandberg* (I); hills near Ramsey, *Sister Mary Milburge* 892 (WS); Rathdrum, *Ash* (I). SHOSHONE: Northwest slope of Binney Point, St. Joe National Forest, *Moore* 484 (WS); 0.5 mile west of Dom Ridge Lookout, St. Joe National Forest, *Moore* 392 (WS); southwest slope of Grizzly Peak, north of Coeur d'Alene River, *Sharsmith* 3595 (W, WS); ridge east of Little Baldy Lookout, *Witt* 1021 (WS). VALLEY: Rocky talus at base of Thunderbolt Mountain, Sawtooth Mountains, *Thompson* 13921 (W); Payette Lake, *Davis* 913 (ISB, WS).

PELLAEA BREWERI D. C. Eaton. BANNOCK: Blackfoot Canyon, *Eggleston* 9995 (US) (7). BEAR LAKE: Bloomington Lake, *Davis* 1641 (ISB, WS). BLAINE: Smoky Mountains, *Macbride & Payson* 3758 (US) (7); high ridge near Stanley Lake, *Thompson* 14042 (W); Boulder Creek Canyon, *Thompson* 14063 (W, WS); head of Boulder Creek, Sawtooth National Forest, *Thompson* 14142 (W, WS). BOISE: Jackson Peak, 10 miles east of Lowman, *H. & M.* 10019 (W, WS). BUTTE: Pass Creek Gorge, Lost River Mountains, about 10 miles north of Leslie, *H. & M.* 8855 (W, WS); head of Mahogany Creek, 2 miles northwest of base of Mount Borah, *H. & M.* 11004 (W, WS). CASSIA: Mount Harrison, *Davis* 1377 (ISB). CUSTER: West base of Ryan Peak, Boulder Mountains, *H. & M.* 10589 (W, WS); talus slope southeast of Double Springs Summit, 8 miles northeast of Dickey, *Cronquist* 3190 (ISB); mountains at head of Redfish Lake, *Evermann* 438 (US) (7); Bonanza, *Macbride & Payson* 3433 (US) (7); Bear Canyon, Mackay, *Nelson & Macbride* 1442 (G) (2). ELMORE: Talus slope above Trinity Lake, about 10 miles west of Featherville, *H. & M.* 10378 (W, WS); Trinity Lake, *Davis* 2092 (ISB). LEMHI: 1 mile southeast of Sleeping Deer Mountain, 37 miles northwest of Challis, *H. & M.* 11354 (W).

PELLAEA BRIDGESII Hook. BOISE (?): Boise National Forest, Divide between Salmon and Payette Rivers, *Grandjean* 96 (US) (7).

CHEILANTHES SILIQUOSA Maxon. BOISE: Elk Lake, headwaters of South Fork, Payette River, above Sacajawea Hot Spring, *H. & M.* 9795 (W, WS). BONNER: Priest Lake, *Piper* 6063 (WS); Mount Hope, *Dunkle* 1388 (I). IDAHO: Headwaters of Sheep Creek, Seven Devils Mountains, *Ownbey & Meyer* 2079 (ISB, W, WS); Seven Devils Lake, *Christ* 12593 (ISB). KOOTENAI: *Sandberg* (WS); Rathdrum, *Ash* (I), *Sister Mary Milburge* 1051 (W); Lone Mountain, *Sister Mary Milburge* 888 (W). SHOSHONE: Along water trail from Little Baldy Lookout, *Witt* 1027 (W, WS).

CHEILANTHES FEEI Moore. CUSTER: About 10 miles southeast of Challis, along road to Mackay, *H. & M.* 15606 (W, WS). IDAHO: *Daubenmire* 37–25 (ISB). LEMHI: About 4 miles south of Lemhi, *H. & M.* 9219 (ISB, W, WS).

CHEILANTHES GRACILLIMA D. C. Eaton. BLAINE: Alpine Creek, northeast of Alturas Lake, *H. & M.* 10530 (W); west side of Alturas Lake, *Cronquist* 2626 (ISB). BONNER: Mount Hope, *Dunkle* (I). BOUNDARY: Hughes Meadows, *Warren* 302 (WS).

BOISE: Mountain east of Elk Lake, headwaters of South Fork, Payette River, above Sacajawea Hot Spring, *H. & M.* 9812 (W, WS). CLEARWATER: Coldwater Ranger Station, *Gail & Long* (I). ELMORE: About 4 miles north of Pine, summit of Dog Mountain, *H. & M.* 8733 (W, WS). IDAHO: Saddle north of Seven Devils Mountains, *Monro* 75 (WS); Dry Diggins, Seven Devils Mountains, *St. John & Mullen* 8462 (WS); Indian Valley, *Davis* 3456 (ISB). KOOTENAI: Spirit Lake, *St. John* 9360 (WS). LATAH: Summit of Cedar Mountain, *Beattie* 4319 (WS); Thatuma Hills, *Beattie* 2907 (WS); Cedar Mountain, *Humphrey* (WS); Moscow Mountain, *Gail* (I). SHOSHONE: Southwest slope of Grizzly Peak, north of Coeur d'Alene River, *Sharsmith* 3597 (W, WS); Gibbson Point Lookout, *Moore* 483 (WS); Little Baldy Lookout, *Witt*, 1028 (WS). VALLEY: Gold Fork Lookout, Sawtooth Mountains, *Thompson* 13796 (W); east face of Mount Brundage, *Davis* 2922 (ISB). WASHINGTON: Rush Creek, *Jones* (W).

MARSILEA VESTITA Hook. & Grev. NEZ PERCE: Shallow river margin, Lime Point, *St. John* 4371 (WS); wet sand on island in Clearwater River, opposite Lewiston, *St. John* 6790 (WS).

AZOLLA CAROLINIANA Willd. *Davis* (ISB). Definitely recorded for the southern part of the state.

EQUISETUM ARVENSE L. BANNOCK: *Davis* 1223, 1968 (ISB). BONNER: Mouth of Clark's Fork River, *Dunkle* 172 (I); Granite Park, *Dunkle* (I). BOISE: Dry Buck, *Macbride* 1695 (WS). CLARK: *Cronquist* 2029 (ISB). CUSTER: *Davis* 1223 (ISB). IDAHO: Lochsa River, *Barkley* 1787 (W). LEMHI: Meyer's Cave, *Davis* 1393 (ISB, W, WS); 8 Mile Creek, about 12 miles southwest of Leadore, *H. & M.* 9244 (W). VALLEY: *Tucker* 1096 (ISB).

EQUISETUM FLUVIATILE L. NEZ PERCE: Spalding, *Rust* (ISB).

Var. LIMOSUM (L). Gilbert. BENEWAH: Lake Chatcolet, *St. John* 9060 (WS). BONNER: Priest Lake, *Piper* 3760 (WS); mouth of Clark's Fork River, *Piper* (I). BOUNDARY: Pack River, *Dunkle* (I).

EQUISETUM KANSANUM Schaffner. BLAINE: *Cronquist* 3453 (ISB). GOODING: *Davis* 1947 (ISB). LATAH: Moscow, *Aldrich* (I). NEZ PERCE: Lewiston, *Beattie* 2302 (WS).

EQUISETUM HYEMALE var. CALIFORNICUM Milde. BONNER: Green Monarch Mountain, *Dunkle* 1428 (I).

EQUISETUM LAEVIGATUM A. Br. BOISE: 20 miles south of Boise City, *H. & M.* 9946 (W); 3 miles south of Boise City, *H. & M.* 9956 (W). BONNER: Lightning Creek, near Hope, *Rust* (ISB).

IDAHO: *Davis* 931, 3199 (ISB); South Fork, Salmon River, *Davis* 2611 (ISB, WS). NEZ PERCE: Spalding, *St. John et al.* 9536 (WS); Lake Winchester, *Jones* 4966 (W); Lapwai, *Rust* (ISB).

EQUISETUM PALUSTRE var. AMERICANUM Victorin. BOUNDARY: Pack River, *Dunkle* 1400 (I).

EQUISETUM PRATENSE Ehrh. CUSTER: 7500 feet, *Cronquist* 2961 (ISB).

EQUISETUM PREALTUM Raf. ADAMS: *Davis* 2445 (ISB). BANNOCK: *Davis* 1999 (ISB). BONNER: *Davis* 3829 (ISB). IDAHO: *Davis* 3721 (ISB).

EQUISETUM SYLVATICUM L. BENEWAH: Alder Creek, *Jones* 504, 696 (WS). BONNER: *Christ* 12985 (ISB). CLEARWATER: *Davis* (ISB).

EQUISETUM TELMATEIA Ehrh. IDAHO: *Davis* 3506 (ISB).

LYCOPODIUM ANNOTINUM L. BONNER: Priest Lake, *Piper* 3755 (WS), *Thompson* 5957 (W); Hughes Fork Trail, *Sipe* (W). BENEWAH: Alder Creek, *Jones* 723 (WS). CLEARWATER: Lolo Creek, near Pierce, *Rust* (ISB). IDAHO: Powell Ranger Station, *Davis* 3605 (ISB). KOOTENAI: *Elmer* 368 (WS).

LYCOPODIUM CLAVATUM L. BONNER: Priest Lake, *Piper* 3751 (W); Hughes Fork Trail, *Thompson* 1197, 6549 (W); trail near Upper Priest Lake, *Sipe* (W). IDAHO: Lochsa River, *Rose* 497 (WS); Lochsa Valley, *Barkley* 1756 (W); Moose Creek, *Shattuck & Fenn* (I).

LYCOPODIUM COMPLANATUM L. BONNER: Trail near Upper Priest Lake, *Thompson* 1196 (W); Priest Lake, *Piper* 3783 (WS). BOUNDARY: Lime Creek, *Warren* 362 (WS). KOOTENAI: *Sandberg* (WS); *Rust* (ISB).

Var. ELONGATUM Victorin. BONNER: Hughes Fork Trail, *Thompson* 5376 (W).

LYCOPODIUM INUNDATUM L. BONNER: Priest Lake, *Piper* 3713 (WS); Sandpoint, *Piper* (WS).

LYCOPODIUM OBSCURUM var. DENDROIDEUM (Michx.) D. C. Eaton. BONNER: Hughes Fork Trail, *Thompson* 5483 (W).

LYCOPODIUM SELAGO L. BONNER: Oxyer Mine, *Dunkle* 1341 (I). BOUNDARY: Near Lime Creek, *Warren* 361 (WS).

Var. PATENS (Beauv.) Desv. BONNER: Hughes Fork Trail, *Sipe* (W, 6042).

LYCOPODIUM SITCHENSE Rupr. Cited for Idaho in Broun's Index to North American Ferns (p. 113).

SELAGINELLA DOUGLASII (Hook. & Grev.) Spring. IDAHO: South

Fork, Clearwater River, *Davis* 3401 (ISB); slopes above Selway Falls, Selway River, *Aase* 1774 (ISB); Middle Fork, Clearwater River, at Three Devils Creek, 4 miles below Lowell, *Constance et al.* 1090 (WS).

SELAGINELLA SELAGINOIDES (L.) Link. CUSTER: Moist meadows adjacent to west end of Stanley Lake, *Worley & Mann* 36–156 (11).

SELAGINELLA SCOPULORUM Maxon. BLAINE: Devil's Bedstead, 8000 feet, *Thompson* 13565 (W). BOISE: Headwaters of South Fork, Payette River, above Sacajawea Hot Spring, *H. & M.* 9813 (W). CUSTER: Vicinity of Stanley Lake, north face of peak to west of Lake Creek, *H. & M.* 9619; western base of Mount Mogg, Lemhi Range, *H. & M.* 11269 (W.) LEMHI: Talus slope near head of Eight-mile Creek, about 12 miles southwest of Leadore, *H. & M.* 9252 (W).

SELAGINELLA WALLACEI Hieron. BOISE: South Fork, Payette River, above Sacajawea Hot Spring, mountain east of Elk Lake, *H. & M.* 9813 (W). BONNER: Hope Mountain, *Dunkle* 1393 (I); Priest River Experiment Station, *Epling* 6969 (W); Priest Lake, *Piper* (W). IDAHO: 15 miles south of Riggins, on Little Salmon River, *H. & M.* 8499 (W); South Fork, Clearwater River, *Davis* 3390 (ISB); cliffs along Snake River, *Davis* 37–22 (ISB). KOOTENAI: Post Falls, *St. John et al.* 4299 (WS). LATAH: Slopes along Potlatch River, 6 miles above Kendrick, *Rogers* 763 (W); Moscow Mountain, *Pickett* 204 (W, WS); northeast ridge, Cedar Mountain, *Beattie* 4310 (W). LEMHI: About 15 miles south of Gibbonsville, along Salmon River, *H. & M.* 9048 (W).

SELAGINELLA WATSONI Underw. CASSIA: Mount Harrison, *Davis* 1375 (ISB). CUSTER: Mount Heyburn, toward creek into Redfish Lake, *Worley & Mann* 36–272 (11).

ISOËTES BOLANDERI Engelm. BONNER: Priest Lake, *Piper* 6068 (WS). IDAHO: Head of Bear Creek, Bitterroot Forest Reserve, *Leiberg* 39 (M) (8), 2939 (US).

ISOËTES HOWELLII Engelm. BENEWAH: Forks of St. Mary's River, *Leiberg* 1149 (US) (8). BONNER: North end of Lake Pend d'Oreille, at Ellisport, *Leiberg* 663 (WS); Lake Pend d'Oreille, *Leiberg* 1663 (US) (8), *Epling* 10056, 10344 (US) (8); lake shore, Sandpoint, *Umbach* (US) (8). CUSTER: Alpine Lake, at base at Mount Heyburn, Sawtooth Range, 8000 feet, *Thompson* 3993 (W). LATAH: Paradise Creek, Moscow, *Henderson* 2894 (M, NY, US) (8); Warren Meadows, *Henderson* 2978 (M); pools near Moscow, *Henderson* (G, WS) (8). KOOTENAI: Lake Coeur d'Alene, *Leiberg* 656 (WS), 1656 (US, W). NEZ PERCE: *Heller* 3482 (M, US) (8). SHOSHONE: St. Mary's Meadow, *Leiberg* 149 (WS).

ISOËTES MURICATA var. HESPERIA Reed (*I. Braunii* auth.). CUSTER: Submerged in small lake at base of Mount Heyburn, *Thompson* 13657 (W, WS). ELMORE: Upper Trinity Lake, about 10 miles west of Featherville, 9000 feet, *H. & M.* 10381 (W). IDAHO: Head of Bear Creek, Bitterroot Forest Reserve, *Leiberg* 17 (M), 2971 (US) (8).

ISOËTES NUTTALLII A. Br. Cited for Idaho in Broun's Index to North American Ferns (p. 102).

ISOËTES MELANOPODA Gay & Dur. Cited for Idaho in Broun's Index to North American Ferns (p. 102).

ISOËTES PAUPERCULA (Engelm.) A. A. Eaton. BONNER: Priest Lake, *Piper* 3689, 3748, 6067 (WS); Lake Coeur d'Alene, *Henderson* 2979 (M), 4786 (G) (8).

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UNIVERSITY OF UTAH.

Notes on Micronesian Pteridophyta

F. R. FOSBERG

Critical study of an accumulation of specimens from Micronesia, largely collected by the U. S. Commercial Company Economic Survey, in 1946, has yielded some new records and observations on the identity and limits of some of the species, as well as a new species of *Gleichenia* (s.l.) These, insofar as they concern the pteridophyte families other than Polypodiaceae (sensu lato, incl. Cyatheaceae), are reported here. The excessive splitting of genera by Ching, Copeland, Reed, and others has, in general, not been followed in identifying these specimens. I have not yet been convinced that most of the broad genera used here are not phylogenetic entities. It seems that, so long as each entity is believed to be monophyletic, the concept of the genus may legitimately be made to emphasize similarities rather than to bring out differences. I can see little to be gained by systematically raising genera to the category of family.

By courtesy of authorities of the Arnold Arboretum, I have been so fortunate as to be able to study quite a number of the specimens cited by Hosokawa in his several papers. I also have had the enormous collections in the U. S. National Herbarium, with some other Micronesian sheets, including some of those collected by Kanehira, available for comparison. It is entirely probable that never before have so many Micronesian Pteridophyta been assembled for study. Herbarium abbreviations are as follows: (US) U. S. National Herbarium; (A) Arnold Arboretum; (Hon) Bernice P. Bishop Museum, Honolulu; (Fo) specimens in my own possession, not yet deposited in any institution.

MARATTIACEAE

ANGIOPTERIS EVECTA (Forst.) Hoffm.

Angiopteris angustifolia Presl.

Angiopteris Beecheyana de Vriese

Angiopteris Durvilleana de Vriese

Angiopteris palauensis Hieron.

Angiopteris palmiformis C. Chr. (at least as to Micronesian records.)

All of the above names have been applied to material from Micronesia, but there is probably only one species present. It is variable, but no more so than in other regions. Specimens may be found to fit most of the descriptions represented by the above names, but such characters as the number of sporangia in a sorus vary from plant to plant, and the variations are by no means characteristic of distinct populations. Leaf thickness varies according to habitat. Sterile material of this may be distinguished from that of *Marattia fraxinea* in a dry state by the presence of a double rather than a single ridge on the ventral (top) surface of the rachis of the pinna between the bases of the pinnules. This useful character was detected by Mr. C. V. Morton. The species is known from Alamagan, Sarigan, Anatahan, and Guam in the Marianas, and from Palau, Yap, Ponape, and Kusaie in the Carolines.

MARATTIA FRAXINEA J. E. Smith.

Gymnotheca Mertensiana Presl.

Marattia Mertensiana C. Chr.

Marattia sambucina Blume

There seems to be only one species of *Marattia* in Micronesia. Whether it should be called *M. Mertensiana* or referred to the widespread *M. fraxinea* is uncertain. The characters of the blades are well within the limits of variation of the latter. Stipes and stipules are lacking from most available specimens from most of the range, so it is hard to tell if they have, in all the range, the abundant scales of *M. Mertensiana.* For the present nothing seems to be gained by separating the two. This species is known mostly, in Micronesia, from Ponape and Kusaie. One collection, *Hosokawa* 9760 (A), from "Sin-Gasupan" [Ngatpang?], Palau, represents an unusually small plant. Further material is needed from Palau to settle the status of this form.

OPHIOGLOSSACEAE

OPHIOGLOSSUM PENDULUM L.

Palau Islands, Angaur, rare on tree trunks, alt. 4 m., *Fosberg* 25963 (US, Hon, Fo). Apparently not previously known from Angaur.

HYMENOPHYLLACEAE

While recognizing that most of the numerous genera maintained by Copeland in this family represent natural groups of species, and that some of them, especially *Mecodium,* are intermediate between *Trichomanes* and *Hymenophyllum* in the widely accepted sense, I can see little to be gained by this undue multiplication of genera. It is usually not at all difficult to place species in one or the other of the old genera, and, in the main, the two seem to be phylogenetically coherent. As long as it is not shown that the large genera are polyphyletic, I see no convincing reason for breaking them up. If there were profound morphologic gaps in them there would be good cause for segregation. There seems to be no valid objection to so-called "cumbersome" genera. Personally, I find large genera with recognizable morphological characters much easier to handle than are swarms of tiny ill-defined ones.

The Micronesian species are few enough so that they are fairly easily identified. A few range extensions, some notes on the status of certain entities, and a new name for one species are here placed on record.

HYMENOPHYLLUM **alternatum** Fosberg, nom. nov.

Trichomanes dichotomum Kunze, Bot. Zeit. **6**: 285. 1848.

Microtrichomanes dichotomum (Kunze) Copel.

Not *H. dichotomum* Nees & Blume (1823), nor Cav. (1802).

There seems little doubt that *Microtrichomanes* belongs with *Hymenophyllum* rather than *Trichomanes*.[1] In Micronesia it is known only from Ponape.

HYMENOPHYLLUM HOLOCHILUM (v.d. Bosch) C. Chr.

Caroline Islands: Kusaie, Mt. Matanta, on tree trunk, dense primary forest, *Fosberg* 26605 (US, Hon, Fo); same loc., open ridge-top, *Fosberg* 26633a (US). Previously known in Micronesia only from Ponape.

HYMENOPHYLLUM POLYANTHOS (Swartz) Swartz.

Caroline Islands: Kusaie, summit ridge of Mount Matanta, abundant on vertical rock-face on open ridge-top, 550–600 m., *Fosberg* 26633 (US, Hon, Fo). Previously known in Micronesia from Palau and Ponape. This Kusaie collection has unusually narrow fronds.

HYMENOPHYLLUM REINWARDTII v.d. Bosch

Mecodium Reinwardtii (v.d. Bosch) Copel.

Known in Micronesia only from Hosokawa's report from Palau.

TRICHOMANES BECCARIANUM Cesati

Caroline Islands: Palau, Babeldaob, "Gaspan" [Ngatpang?], *Hosokawa* 9666 (A). I can not find that this has been previously reported from Micronesia.

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[1] See Copeland's discussions, Phil. Journ. Sci. **51**: 153–4. 1933; **64**: 12. 1937; **67**: 35–36. 1938.

TRICHOMANES BIMARGINATUM v.d. Bosch

Caroline Islands: Palau, Babeldaob, "Gaspan" [Ngatpang?], *Hosokawa* 9667 (A). Hosokawa, himself, reduced his *Crepidomanes pseudo-nymani* to synonymy under *Microgonium craspedoneurum* (*Trichomanes c.*), where the type and other Ponape specimens properly belong. The Palau specimen cited, however, at least the Arnold Arboretum sheet of it, is *T. bimarginatum.*

TRICHOMANES BIPUNCTATUM Poir.

Caroline Islands: Palau, Babeldaob, "Gaspan" [Ngatpang?], *Hosokawa* 9644 (A). Known previously in Micronesia from Ponape.

TRICHOMANES BREVIPES Baker

Caroline Islands: Truk, "Suiyo-to," *Hosokawa* 8318 (A). Previously known in Micronesia from Guam. Whether this is really distinct from *T. bilabiatum* Nees & Blume is not very clear from Copeland's treatment.[2]

TRICHOMANES CRASPEDONEURUM Copel.

Caroline Islands: Truk, Tol, "Uriribot," *Hosokawa* 8267 (A), 8291 (A); "Wara, Mt. Tukuman," *Hosokawa* 8462 (A). Previously known in Micronesia from Ponape.

TRICHOMANES GRANDE Copel.

Caroline Islands: Kusaie, Mt. Fenkol, 1000 ft., *Hosokawa* 6382 (A); "Utuwa-kyahon," *Hosokawa* 9375 (A). Not previously reported from Micronesia, though No. 6382 was reported by Hosokawa[3] as *T. maximum* Blume.

TRICHOMANES JAVANICUM var. **Boryanum** (Kunze) Fosberg, comb. nov.

Trichomanes Boryanum Kunze, Farnkr. 237, pl. 97. 1847.

Trichomanes alatum Bory in Bot. Duperr. Voy. 282, t. 38, f. 2. 1826, non Swartz (1801).

[2] Phil. Journ. Sci. **51**: 174–184. 1933.
[3] Trans. Nat. Hist. Soc. Formosa **26**: 48. 1936.

Kunze's *T. Boryanum,* based on *T. alatum* Bory, differs from *T. javanicum* Blume in the flaring mouth of the involucre and in being slightly less variable in other characters. Specimens from Guam, according to Copeland[4] and Wagner & Grether[5] vary toward *T. atrovirens,* of the Philippines, in the not greatly dilated mouth of the involucre. However, several specimens that seem otherwise to be *T. javanicum* have somewhat flaring involucres. Such are *Ramos* 1268 and *Boden-Kloss* 19170 from Borneo, and *H. M. Smith* 206, 611, 601 (all US) from Siam. Only the Boden-Kloss collection could be *T. atrovirens* in Copeland's sense. These specimens probably do not represent the same variant as *T. Boryanum,* but they certainly simulate it. To recognize the slight differences that actually exist and at the same time not to overemphasize them, it would seem a better disposition to regard at least what have been called *T. Boryanum* and *T. atrovirens* as geographical varieties of *T. javanicum.* Even as such they are rather weak. This seems scarcely the place to make the combination for the Philippine variety, so only the Micronesian one is considered here. The type locality of Bory's *T. alatum* is Ualan (Kusaie). The range of the variety, as known at present, is Guam, Kusaie, Ponape and Palau. The latter record is based on *Hosokawa* 9253 (A), from Mount Elsum, Palau.

TRICHOMANES MINUTUM Blume

Caroline Islands: Nukuoro Atoll, Nukuoro Islet, rare on tree-trunks, *Fosberg* 26219 (US, Hon, Fo). This has not been known previously from any atoll in Micronesia, though reported from Guam by Wagner and Grether as *Gonocormus minutus* and from Palau, Ponape, Truk, and Kusaie by Hosokawa as *T. parvulum.*

[4] *op. cit.,* 255.
[5] B. P. Bishop Mus. Occ. Pap. **19**: 38. 1948.

TRICHOMANES RIGIDUM Swartz

Copeland[6] says "after examining very many specimens of most of the species in great detail, I am satisfied that no other sharp line can be found separating *T. rigidum, T. mandioccanum, T. cupressoides, T. obscurum, T. dentatum, and T. elongatum,* save those that can be drawn on a map." Then he went ahead and maintained them as separate species. This would not be objectionable if the resulting species were distinct enough except for fuzziness around the lines drawn on the map. However, after examining the extensive collection in the U. S. National Herbarium, including much material annotated by Copeland, I can see nothing but a great mass of varying individuals. The Old World specimens generally have stipes more congested on the rhizome than Jamaican ones do, but the two populations overlap one hundred percent in this character, as well as in all others that I have studied. Since there seems to be no tangible geographic separation of the variations in the group I see no reason for keeping them separate. In Micronesia *T. rigidum* is known from Palau, Yap, and Ponape.

GLEICHENIACEAE

Several authors of treatises on ferns, such as Presl, Maxon, Ching, Copeland, Christensen, Chrysler, and others have divided the genus *Gleichenia,* following, in general, recently, the arrangement of sections and subgenera by Hooker and Baker and by Diels. So far as I know, no one has suggested that these groups have a different ancestry, but merely that they can be separated by means of key characters. Chrysler[7] has pointed out some real but mostly rather inconstant anatomical differences. One can agree with Copeland that "a genus is a convenient group of related species." There has

[6] *op. cit.*, 232.

been no suggestion that the species of *Gleichenia* are not related. It remains to be shown that the group in its broad sense is not convenient.

In Micronesia, heretofore, two species have been reported, one of which is the widespread *G. linearis;* the other, *G. ferruginea,* is here considered a variety of *G. linearis.* In addition to those, I found on Kusaie a highly different-looking population which seems deserving of specific rank.

GLEICHENIA LINEARIS (Burm. f.) Clarke

Marianas Islands: Rota, highest hill on island, near Sabana, common on banks of old excavation in weathered volcanic material, 480 m. alt., *Fosberg* 25032 (US, Hon, Fo).

This species is already known from almost all of the other high islands in Micronesia, except Tinian and most of the volcanic northern Marianas. According to Dr. Josiah Bridge, this species and its variety (below) are frequently associated with bauxite deposits in Micronesia. All of the specimens that I have seen from Palau have been of the following variety.

GLEICHENIA LINEARIS var. FERRUGINEA (Blume) v. Ald. v. Rosenb. Mal. Ferns 59. 1908.[8]

Gleichenia ferruginea Blume, Enum 249. 1828.

Dicranopteris ferruginea (Blume) Hosokawa, Trans. Nat. Hist. Soc. Formosa **25**: 435. 1935.

This resembles the Hawaiian plant usually called *Gleichenia emarginata* Brack. (which certainly is not more than a variety of *G. linearis* in my sense) in the rusty tomentose under sides of the fronds, but the Palau plant differs in its long-caudate blades (pinnae), in the

[7] Amer. Journ. Bot. **31**: 483–491. 1944.

[8] Some may consider this combination to have been made by Christensen, Ind. Fil. 321, 1905, where he says "Gleichenia ferruginea Bl. Enum. 249, 1828 = G. linearis var."

less venulose upper surface of the pinnules, and in the less generally and less prominently emarginate tips to the pinnules. There seems to be a tendency in many places for *G. linearis* to show more or less rusty-tomentose forms. It seems probable that strongly tomentose populations have arisen independently in several regions.

Caroline Islands: Palau, Babeldaob, Garamiscan Colony, very abundant on red clay soil, dominant in eroded and disturbed areas, 75 m. alt., *Fosberg* 25692 (US, Hon, Fo); Koror, north section, in open places in forest, 50 ft. alt., *Hosaka* 3333 (US, Hon, Fo). Previously reported from Babeldaob by Hosokawa, not as yet known in other parts of Micronesia.

GLEICHENIA **Weatherbyi** Fosberg, sp. nov.

Planta robusta, rhizomate 5–6 mm. crasso dense lanato, stipitibus 30–40 cm. distantibus ad 1 m. longis ad apicem furcatis, segmentis penultimis 4–5 mm. crassis, lamina 40–50 cm. longa, chartacea, segmentis ad 9 cm. longis, 6–7 mm. latis.

Extremely robust plants forming dense tangled masses of fronds; rhizome sub-superficial, sparsely clothed with roots, extensively creeping, about 5–6 mm. thick, with a thin sclerified cortex and a wide soft pithlike stele which readily disappears, leaving the rhizome hollow in its older parts, densely clothed with a loose golden-chestnut-brown wool, the hairs 5–7 mm. long; fronds 30–40 cm. apart, several meters long; stipes 1 cm. thick, densely ferruginous-woolly, fistulose when young, up to 1 meter long or more to first forking, forked 3 or more times, becoming somewhat glabrate above, bearing at each forking 2 or even 3 pairs of stipular pinnae, one of these small, erect, surrounding the brown-woolly terminal bud, palmately veined and lobed, the lobes pinnately and irregularly lobed, the other two pairs somewhat reflexed from lower sides of the forks, straight, pectinate, the larger pair as much as 35 cm. long and 12 cm. wide, subequally pectinate on both sides, becoming smaller and more irregularly or unequally pectinate on successive forkings, the smaller pair only occasionally present on lower forkings, borne on inner sides of bases of the larger pair, often unequally developed; penultimate segments of rhachis 4–5 mm. thick in greatest diameter, somewhat compressed; ultimate pinnae with pectinate lamina up to 40–50 cm. long, the pinnules chartaceous, up to 9 cm. long, 6–7 mm. wide well above base, narrowed in distal half to a blunt or emarginate point, expanded and confluent at base for 1–2 mm., the sinuses rounded to pointed, calloused, the margins somewhat revolute, the veins forked once at base, the distal branch forked again shortly above base, the proximal branch of this forking forked again half-way to its extremity; sori on veins $\frac{1}{3}$ to $\frac{1}{2}$ way to the margin, comprising 7 to 15 sporangia; hairs of stipe and part of those sparsely scattered on under side of blade stellate, bur-like under high magnification, their branches irregular in length, multicellular, terete, glistening red-brown, the others on pinnules of blade transparent, simple or branched; hairs of rhizome and basal part of stipe simple or rarely branched, glistening, multicellular, the cells tending to collapse decussately; hairs of roots unicellular, stiff, glistening.

Caroline Islands: Kusaie, south slope of Mount Tafayet, easternmost high peak in range culminating in Mount Crozer, south of Lela Harbor, 500 m. alt., Aug. 21, 1946, *F. R. Fosberg* 26672 (type in US, isotypes Hon, Fo).

This plant was observed in a large colony on a steep slope and was strikingly different from *G. linearis* as observed growing on the same island. It would undoubtedly be called a *Dicranopteris* by those who split *Gleichenia*. Its closest relative is probably *G. linearis*, which it resembles, but is several times larger in all parts. The soft, pith-like stele in the rhizome is much thicker in proportion to the sclerified cortex than in *G. linearis.* In its size it resembles another relative of *G. linearis, G. splendens* of Indo-China and Yunnan, but in the latter the pinnules are broader, thinner, differently shaped, further apart, and very glaucous. The two are probably parallel offshoots, possibly polyploids, of the widespread *G. linearis.* The species is dedicated to the memory of Charles A. Weatherby who was, at the same time, one of the most level-headed and careful scholars and one of the most charming and distinguished personalities in American botany.

SCHIZAEACEAE

LYGODIUM CIRCINNATUM (Burm. f.) Swartz

Caroline Islands: Palau Group, Angaur, in brushy secondary vegetation on elevated limestone, 25 m. alt., *Fosberg* 25901 (US, Hon, Fo); Arakabesan Island, west side, in secondary woods, 1–20 m. alt., *Fosberg* 25632 (US, Hon, Fo). These are apparently the first records from these islands of the Palau Group, though Hosokawa recorded it on Koror and Babeldaob. It is also known from Yap and Truk.

LYGODIUM CIRCINNATUM var. **semihastatum** (Cav.) Fosberg, comb. nov.

Ugena semihastatum Cav. Ic. **6**: 74, t. 594, f.1. 1801.

Lygodium semihastatum (Cav.) Desv. Prodr. 203. 1827.

Comparison of a considerable number of sheets of this Guam plant with a large series of *L. circinnatum* from over its extensive range shows that all of the obvious characters of the former are well within the range of variation of *L. circinnatum,* excepting the strong tendency toward an obliquely lobed or "semihastate" base to the fertile and, at times, the sterile segments. The only tendency toward a lobed base observed on material from outside Guam was a slight one on a few specimens from Borneo and China. Some of the latter have been referred by Ching to *L. digitatum* Presl. Sterile pinnae have not often been collected on Guam specimens, and those present are cut more deeply than in many sheets from elsewhere, but this is by no means rare in the rest of the range of the species. Since the variation is only in one character, and that not a seemingly fundamental one, and since Guam is on the periphery of the range of *L. circinnatum,* where somewhat distinctive populations may be expected, it would seem best not to overemphasize this difference by according the Guam population specific rank. Therefore I am regarding it as a geographical variety.

SCHIZAEA DICHOTOMA (L.) J. E. Smith

At first sight the plant referred by Hosokawa[9] to *S. Biroi* Richter appears to be a satisfactorily distinct species, characterized by its few (not over four) ramifications, open branching habit, short terminal segments, few fertile pinnae, and absence of sterile fronds. Plants of this nature are found in Guam, Ponape, and (according to Hosokawa) Kusaie, while the ordinary form is found on Palau and Yap. I have not seen authentic material, or even the description, of *S. Biroi,* so do not know if this material is properly associated with it. Examination of the extensive material of *S. dichotoma* in the U. S. National Herbarium, however, shows that specimens more or less similar to this are found through much of the range of *S. dichotoma.* Such specimens come from Tahiti, Fiji, Java, the Philippines, Australia, etc. Intermediate plants are available from Tahiti, Samoa, Su-

[9] Trans. Nat. Hist. Soc. Formosa 31: 468. 1941.

matra, etc. Viewed broadly, the specific distinctness of this plant becomes doubtful, and it seems likely that at least some of the specimens are merely depauperate forms from unfavorable habitats. However, the Micronesian occurrence, at least, suggests genetic distinctness. The strikingly distinct appearance of the specimens, with no intergrades, and the distinct geographic range would leave one no choice but to call it a distinct species, if the remainder of its range were not studied. My present inclination is to regard the Micronesian plants as a geographical variety. None of the names applied to such forms—*S. Forsteri* Spreng., *S. cristata* Willd., *S. Biroi* Richt., or *S. kikuzatonis* Ogata—are based on Micronesian material. Since it is permissable to ignore earlier names in other ranks, and since it is likely that the plants from other regions are not really connected with this variety, I take pleasure in naming it for the present day authority on this genus, Dr. Olaf Selling, of Stockholm.

SCHIZAEA DICHOTOMA var. **dichotoma** (L.) Fosberg, nom. nov.

Acrostichum dichotomum L. Sp. Pl. 1068. 1753.

This is the typical, ample form with long segments and five to nine ramifications and a close branching habit. In Micronesia it is found on Palau and Yap.

SCHIZAEA DICHOTOMA var. **Sellingi** Fosberg, var. nov.

Folia 3–4 furcata, laxa, segmentis brevibus, pinnis fertilibus paucis.

Caroline Islands: Ponape, Mount Tolun Nanket, above Nanipil, 600 meters alt., under trees on wet, mossy ridgetop, *Fosberg* 26422 (type, US; Hon, Fo); "Mt. Ringel humoto Gensei rin, 100 m.," *Hosokawa* 9558 (A) (same number published with locality Reitau River, near Matalanim by Hosokawa in 1941). Also reported from Kusaie by Hosokawa, but I have not seen any Kusaie material. Marianas Islands: Guam, ½ mile s.w. of Mount Santa Rosa, on ground in moist, dense woods, *Moore* 375 (US); Ylig Valley, on rotten log in dense shade, 200 ft., *Steere* 51 (US); headwaters of Ylig River, on rotten log in shady place, *Rodin* 621 (US).

SCHIZAEA PONAPENSIS Hosokawa, Trans. Nat. Hist. Soc. Formosa **31**: 39. 1941.

S. inopinata Selling, Svensk Bot. Tidskr. **40**: 274–278. 1946.

This species may no longer be considered a Micronesian endemic, since it appears in all characters to be identical with Selling's species, which has a much wider range, extending from Malaya and the Philippines. It superficially resembles *S. digitata,* which also occurs in Palau, but differs in the two (instead of four) rows of much larger sporangia in each fertile segment.

LYCOPODIACEAE

LYCOPODIUM CERNUUM L.

Caroline Islands: Palau, Arakabesan, w. side, on steep slope, on soil derived from volcanic breccia, 1–20 m. alt., *Fosberg* 25638 (US, Hon, Fo). With this record this species is known from most of the high islands of Micronesia, excepting the northern Marianas other than Alamagan.

LYCOPODIUM PHYLLANTHUM H. & A.

Caroline Islands: Ponape, Tolun Nanket, Not Distr., epiphytic on tree-trunk in wet mossy ridge-top forest, 600 m. alt., *Fosberg* 26415 (US); "Coloma [Colonia?]—Palkier kan Nanponmaru sisakuti hukin," *Hosokawa* 9597 (A). This species is principally found in Hawaii, though specimens are known from the southwestern Pacific. It is a coarser plant with notably thicker spikes than *L. Phlegmaria,* with which it grows on Ponape.

LYCOPODIUM SQUARROSUM Forst.

Lycopodium Hippuris Desv.

Lycopodium ulicifolium Vent.

Urostachys cunninghamioides (Hayata) Herter ex Nessel

Nessel[10] recognizes about fifteen species and a number of varieties and forms in his "Untergruppe Squarrosa" of *Urostachys.* After examining the material in the U. S. National Herbarium I fail to find much basis for such a classification. Capt. van Alderwerelt van Rosenburgh,[11] likewise, proposes a classification on the basis of the degree of contraction of the fertile spike, which places *L. squarrosum, L. ulicifolium,* and *L. Hippuris* in three "groups" arranged in two subsections. This seems unnatural, and seems not to have any geographical significance. *L. squarrosum* is undeniably variable, certain specimens having somewhat longer leaves, and others, especially Philippine ones, having finer leaves, but the impression I have is of a somewhat variable single species. One would, of course, expect variability in a species ranging from Africa to Tahiti and Kusaie. The variations are not much restricted geographically. I am, therefore, treating this complex, of which four "species" have been reported from Micronesia, as *Lycopodium squarrosum* Forst. *sens. lat.*

Caroline Islands: Kusaie, slopes of Mount Tafayet, on mossy tree trunks in thick wet forest, *Fosberg* 26670 (US, Hon). Previously recorded in Micronesia from Palau and Ponape.

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10 In Die Bärlappgewächse 197–207. 1939.

11 Mal. Fern Allies 27–46. 1915.

PSILOTACEAE

PSILOTUM COMPLANATUM Swartz

Caroline Islands: Ponape, Mount Tamatamansakir, epiphytic in primary forest, 150–250 m. alt., *Fosberg* 26300 (US, Hon, Fo); Nukuoro Atoll, Shenukdai Islet, rare on dead log in shade (mixed with *P. nudum*), *Hosaka* 3481a (US). Previously known in Micronesia from Alamagan, Palau and Kusaie.

PSILOTUM NUDUM (L.) Griseb.

Caroline Islands: Truk, Pis Islet, rare at bases of coconut trees in edge of forest on flat coral debris, 1–2 m., *Fosberg* 24677 (US, Hon, Fo); Nukuoro Atoll, Shenukdai Islet, on dead log in shade, 5 ft. alt., *Hosaka* 3481 (US). Previously known in Micronesia from Guam, Rota, Truk (Fefan), Yap, and Palau. Dr. Alan Burges of the University of Sydney, Australia, informs me (in litt.) that he collected it in 1934 on Nauru. It is likely that it will eventually be found on most of the other islands excepting possibly some of the drier atolls of the Marshalls and Gilberts.

PACIFIC VEGETATION PROJECT, CATHOLIC UNIVERSITY OF AMERICA, *Washington, D. C.*

State and Local Fern Floras of the United States. Supplement I

S. F. BLAKE

In 1941 the writer published in this journal[1] a list of state and local fern floras of the United States, geographically arranged and briefly annotated. It contained 217 primary and 88 supplementary titles, a total of 305.[2] The present supplement contains 81 new titles, of which 42 are primary and 39 supplementary. Besides full lists and descriptive floras, it includes references to all additions to state lists (excluding those in monographs and revisions) that have come to my attention. As before, state lists are distinguished by an asterisk. A dagger is placed before the entries of local lists already in the 1941 bibliography for which supplements are here recorded. With the latter, and with the state lists which are cited in connection with additions directly following the names of the respective states, parenthetical references are given to the pages of the original bibliography on which they were mentioned. The only greatly contracted abbreviation used is A. F. J., for the name of this journal.

The introduction to the earlier bibliography included mention of various general works on United States ferns. The following titles should be added: Morton, Conrad V. Index of illustrations, American Fern Journal, volumes 1–38. A. F. J. **39**: 75–82. 1949. (Alphabetical list of all illustrations of Pteridophyta published in the American Fern Journal, 1910–1948); Wherry, Edgar T., comp. American Fern Journal. Cumulative index, volumes 1–25, 1910 to 1935 inclusive. A. F. J., v. 29, no. 4, suppl.,

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[1] Amer. Fern Journ. **31**: 81–90, 131–143. 1941.

[2] These figures relate to the list proper. The figure of 314 given in A. F. J. **31**: 84 is incorrect.

88 p. 1939. (Includes author, subject, geographic, and systematic indices.)

Each of the 48 states, as well as the District of Columbia, now possesses at least a nominal list of its fern flora; but those for Nevada and the District of Columbia are unusable in their present condition.[3] Two-thirds (actually 34) of these have been produced in the twenty years from 1930 on; the greatest number for any 5-year period was 12 for the 1936–40 lustrum. The 15 fern floras of older date are the following: Minnesota, 1903 (with later lists, without data on distribution, in 1909 and 1946); Montana, 1904; Georgia, 1905; Connecticut, 1910 (supplement in 1931); Michigan, 1912; Washington, 1913–14; New Mexico, 1915; North Dakota, 1918; District of Columbia, 1919 (includes adjacent areas in Maryland and Virginia); Alabama, 1920 (Filicineae and *Lycopodium* only); Nebraska, 1923; Mississippi, 1921; California, 1923; New York, 1924; Nevada, 1925 (combined with Utah). Of these, those for Connecticut and New York are quite full and probably still give a sufficiently detailed picture of our knowledge of the fern flora, and there are some of the other states, such as Mississippi and New Mexico, in which not much collecting has been done since their floras were issued. Of the 34 lists or full floras published from 1930 on, the great majority are

[3] The records for Nevada are so inextricably combined with those for Utah that from the published flora alone (Tidestrom's Flora of Utah and Nevada) it is impossible to be sure whether some species occur in Nevada or not; and Maxon's fern flora of the District of Columbia, like Hitchcock and Standley's Flora of the District of Columbia and vicinity, covers not merely the District proper but a circle 15 miles in diameter about the Capitol as a center, thus including areas in adjacent Virginia and Maryland which have no ecological equivalent in the District. Its total of 53 species includes a number that occur only outside the boundaries of the District. Reed's list (1943) goes as far in the other direction, failing to indicate the occurrence of *Osmunda, Pteridium, Pellaea, Polystichum, Polypodium, Onoclea,* and others in the District of Columbia.

quite satisfactory; however, those for Idaho[4] and Rhode Island have little or no data on distribution, those for Rhode Island, Maine, and Tennessee cover the Filicineae only (but there is a contemporaneous list of vascular plants of Maine that includes the fern-allies), the two for Delaware have their records confusingly intermingled with those for adjacent regions, and, of the two for Maryland, one is a bare list of names and the other (by Reed) has its records combined with those for Delaware and the District of Columbia; the picture of Maryland fern life is not much obscured thereby, however, since every form listed, except nos. 15 and 118, is recorded from Maryland.

In the preceding paragraph mention has been made of the states that seem to be most in need of new fern floras; it is hoped that members of the American Fern Society who are favorably situated will be moved to provide some of these. A few points should be borne in mind in preparing them. Whoever writes a fern flora should by all means cover the whole group of Pteridophyta, not merely the Filicineae. The practical convenience of having all the vascular cryptogams together in one work far outweighs the theoretical consideration that the Filicineae are less closely related phylogenetically to the "fern-allies" than they are to the phanerogams. The author, in presenting his statistics as to number of species, varieties, and so on, should remember that a species represented in a given flora by a single variety or form is counted as a species, not as a variety or form. Disregard of this elementary principle renders unreliable the statistics in Broun's otherwise very useful Index to North American Ferns. Let the author cover a single state or part of a state at a time, not try to comprehend two or more states or parts of states in the same list;

[4] This deficiency is remedied by Dr. Flowers in this number of the JOURNAL. [Ed.]

whatever profit the ecological or phytogeographical point of view may derive from this procedure is likely to be more than discounted by the floristic obscurity that seems almost invariably to attend such endeavors. The author, when deciding whether to follow a systematic or an alphabetical arrangement for his list, should remember that the order of generic and family arrangement changes, but the composition of the families and larger groups is fairly stable. The most satisfactory arrangement, in the writer's opinion, is systematic for families, alphabetical for the genera and species under them; but the number of families ordinarily recognized is so few that it makes little difference, from the point of view of convenience, whether they are arranged alphabetically or systematically. The placing of all the genera, fern-allies as well as ferns, in a single alphabet is undesirable, as it gives a less clear picture of the composition of a flora.

An attempt has been made to work out the number of species and forms known from each state, on the basis of the floras listed in the earlier bibliography and in this supplement, but the figures can not be regarded as more than approximately correct. To make them as nearly comparable as possible, Broun's Index to North American Ferns has been followed for specific delimitation. These figures are inserted for all the states, even for those with no addition to their bibliography, in the supplement that follows. The total number of species is given first, followed in parenthesis by the respective numbers for ferns proper (Filicineae) and for fern-allies, separated by a dash, and these are followed by the number of subspecies, varieties, forms, and hybrids that have been recorded, combined under the term infra-specific forms and hybrids. The last figure varies in the different states from zero to 109 (Vermont); although of no great importance in itself, it may be in some cases a guide to the thoroughness with which a given flora has been worked up, although in others it is merely an indication that the author chose to disregard minor variations.

A certain interest attaches to these figures, but it must be emphasized that they are only approximate, there being often a leeway of 1, 2, or 3, except when the figure is based on a single authoritative modern list; consequently, the relative standing of the different states, based on the number of species in their respective floras, is really much less definite than appears in the following list. The counts in all cases are the present writer's own, and have been repeated until at least two counts of the same list agreed; the original authors' own counts, in many cases, were either flatly erroneous or required alteration to bring their specific categories into agreement with Broun, or both. The figures given include the more or less naturalized (but not the adventive or casual) species, which in several of the eastern and southern states amount to from 1 to a maximum (Florida) of 11 species; if these were subtracted from the totals, the relative standing of several states would be changed. The list of states, with the approximate total numbers of known species, is as follows:

Florida, 127 species; Texas, 103; New York, 93; California, 85; Arizona, 84; Michigan, Vermont, 81; New Jersey, Pennsylvania, 78; Connecticut, Maine, Virginia, Wisconsin, 77; Massachusetts, 76; Maryland, New Hampshire, North Carolina, Ohio, 74; Minnesota, Washington, 72; Alabama, Oregon, West Virginia, 68; South Carolina, 66; Idaho, 63; Illinois, 62; Louisiana, Tennessee, 61; Georgia, 60; Arkansas, Montana, Rhode Island, 57; Missouri, 55; Colorado, Oklahoma, 54; [District of Columbia], Iowa, Kentucky, Utah, 53; Delaware, Indiana, 51; New Mexico, 41; South Dakota, 37; Mississippi, 36; Wyoming, 34; Kansas, 31; Nevada, 29; Nebraska, 27; North Dakota, 19.

ALABAMA

Total fern flora 68 species (53–15) and 10 infraspecific forms and hybrids; includes 5 introduced species of Filicineae.

The latest state lists are: Graves, E. W. The fern flora of Alabama. A.F.J. **10**: 65–82. *pl. 1.* 1920. (A.F.J. **31**: 84. 1941); Mohr, C. T. Plant life of Alabama. 1901. (See below.)—For additions, see Clausen, Robert T. Ophioglossum vulgatum on the inner Coastal Plain of Alabama. A.F.J. **32**: 105–108. 1942.—Also Crawford, Lloyd C. Dryopteris setigera in Alabama. A.F.J. **39**: 124. 1949.

* **Mohr, Charles T.** Plant life of Alabama. Contr. U. S. Nat. Herb. v. 6. 921 p. 13 pl. (incl. map). 1901. (Reprinted as "Alabama edition," publication of Alabama Geological Survey.)—Includes (p. 310–322) annotated list of Pteridophyta, with localities for scarcer species. The list includes *Azolla, Equisetum, Selaginella,* and *Isoëtès,* omitted by Graves (1920).

ARIZONA

Total fern flora 84 species (71–13) and 6 infraspecific forms.

* **Phillips, Walter S.** A check-list of the ferns of Arizona. A.F.J. **36**: 97–108. 1 fig. (map). 1946; **37**: 13–20, 39–51. 1947. —Previous publications, local herbaria, gazetteer (with map); annotated list of Pteridophyta, with citation of localities and exsiccatae, the whole arranged in a single alphabet; list of doubtful and excluded species; bibliography.

ARKANSAS

Total fern flora 57 species (49–8) and 12 infraspecific forms and hybrids.

The latest state list is: Moore, Dwight M. Arkansas Pteridophyta. A.F.J. **30**: 105–119. 1940. (A.F.J. **31**: 85. 1941.)—For additions, see Demaree, Delzie. Arkansas fern notes. A.F.J. **33**: 75. 1943. (Adds 2 infraspecific forms.)

CALIFORNIA

Total fern flora 85 species (57–28) and 20 infraspecific forms.

The latest state lists are: Jepson, Willis L. A manual of the flowering plants of California. 1923–25. (Pteridophyta, p. 25–44.

f. 1–33.) (A.F.J. **31**: 85. 1941); Parish, Samuel B. The fern flora of California. Fern Bull. **12**: 1–15. 1904. (A.F.J. **31**: 86. 1941.)—For addition, see Ewan, Joseph. Asplenium septentrionale in California. A.F.J. **33**: 29. 1943.

Howell, John T. A key to the pteridophytes of Marin County, California. The Wasmann Collector **4**: 139–144. 1941.—Rare species, habitats, etc.; unannotated key to species; bibliography. Replaces his mimeographed paper (not seen) with similar title in Sierra Club Nature Notes **6**: **1–9**. 1940.—See also his Marin flora. Manual of the flowering plants and ferns of Marin County, California. Berkeley, Los Angeles, 1949.—(Includes (p. 49–55) annotated, keyed list of pteridophytes.)

Colorado

Total fern flora 54 species (38–16) and 2 infraspecific forms.

Connecticut

Total fern flora 77 species (51–26) and 48 infraspecific forms and hybrids.

Delaware

Total fern flora 51 species (34–17) and 13 infraspecific forms and hybrids.

See also ***Reed, C. F.**, under Maryland.

* **Tatnall, Robert R.** Flora of Delaware and the Eastern Shore. An annotated list of the ferns and flowering plants of the peninsula of Delaware, Maryland and Virginia. xxvi, 313 p. 9 pl., map. 23.5 cm. n. p., 1946 [1947].—Includes (p. 1–10) annotated list of Pteridophyta [56 species known from the whole area]. The species known from Delaware are not distinguished typographically from the others.

District of Columbia

Total fern flora (Maxon, 1919) 53 species (40–13), but this includes a number not found in the District; Reed (1943) definitely lists only 16 (11–5), far too small a number.

The latest lists are: Maxon, William R. Ferns of the District of Columbia. A.F.J. **9**: 38–48. 1919. (A.F.J. **31**: 87. 1941): Reed, C. F. County distribution of the ferns and fern-allies in Maryland, Delaware and District of Columbia. 1943. (See below, under Maryland.)—For addition, see Irving, Frank N. Pteris vittata hardy in Washington, D. C. A.F.J. **33**: 28. 1943. (Adventive.)

FLORIDA

Total fern flora 127 species (111–16) and 6 infraspecific forms and hybrids; includes about 11 introduced Filicineae. The total figure includes 9 species of *Asplenium* and *Dryopteris,* recognized by Broun, that were published by E. P. and R. P. St. John and by Small after Correll's list was written.

The latest state list is: Correll, Donovan S. A county checklist of Florida ferns and fern allies. A.F.J. **28:** 11–16, 46–54, 91–100. map. 1938. (A.F.J. **31:** 87. 1941.)—See also Ewan, Joseph. On the occurrence of Asplenium adiantum-nigrum in Florida. A.F.J. **36:** 18–19. 1946. (Record is considered erroneous.)

Murrill, William A. Ferns of Alachua County. *In* his Ferns. p. 64–67. 22.5 cm. Gainesville, Fla., 1947.—Keyed list of Pteridophyta, annotated as to abundance.

Simpson, Charles T. Ferns of Highlands Hammock. *In* Donaldson, Charles S., and others. The plant life of Highlands Hammock. p. 58–61. 23 cm. Lake Wales, Fla., 1934.—Annotated list of Pteridophyta, arranged alphabetically. (Highlands County.)

Spurr, Stephen H. Notes on the distribution and habits of the ferns of northern peninsular Florida. Proc. Florida Acad. Sci. 5: 62–72. 1941.—List of numerous species of Filicineae with notes on habitat, distribution, and localities.

GEORGIA

Total fern flora 60 species (45–15); includes 4 introduced Filicineae.

The latest state list is: Harper, Roland M. The ferns of Georgia. Fern Bull. **13:** 1–17. 1905. (A.F.J. **31:** 87. 1941.)—For additions, see Duncan, Wilbur H., New records of two ferns in Georgia. A.F.J. **38:** 69–70. 1948. (*Equisetum laevigatum* and *Dryopteris goldiana.*)

IDAHO

Total fern flora 63 species (35–28) and 8 infraspecific forms.

***Flowers, Seville.** A list of the ferns of Idaho. A.F.J. **40:** 121–130. 1950.—Annotated list of Pteridophyta, with citation of localities and collectors; bibliography. Includes 63 species, of which 5 are given on the basis of previous records unaccompanied by localities or names of collectors. Replaces his Pteridophytes.

Contributions toward a flora of Idaho no. 27. 1 p. l., 37 p. 28 cm. Pocatello, Idaho, 1949. (Keyed descriptive flora, the Idaho range given only in the most general terms. Processed publication.)

ILLINOIS

Total fern flora 62 species (48–14) and 2 infraspecific forms and hybrids.

* **Jones, George N.** An enumeration of Illinois Pteridophyta. Amer. Midl. Nat. **38**: 76–126. 1947.—Annotated, keyed, briefly descriptive flora of Pteridophyta, with references, citation of collectors and localities; bibliography.

INDIANA

Total fern flora 51 species (34–17) and 26 infraspecific forms and hybrids.

The latest state lists are: Deam, Charles C. Flora of Indiana. 1940. (Pteridophyta, p. 37–66.) (A.F.J. **31**: 88. 1941); Greene, Frank C. The fern flora of Indiana. Fern Bull. **19**: 102–115. map. 1911 [1912]. (A.F.J. **31**: 88. 1941.)—For addition, see Jones, George N. Lycopodium tristachyum in Indiana. A.F.J. **36**: 17–18. 1946.

IOWA

Total fern flora 53 species (38–15) and 2 infraspecific forms.

KANSAS

Total fern flora 31 species (25–6).

The latest state list is: Gates, Frank C. Annotated list of the plants of Kansas: ferns and flowering plants. 1940. (Pteridophyta, p. 104–105). (A.F.J. **31**: 89. 1941.)—For addition, see McGregor, Ronald L., and Worthie H. Horr. Selaginella rupestris in Kansas. A.F.J. **39**: 16–17. 1 fig. (map). 1949.

KENTUCKY

Total fern flora 53 species (45–8) and about 10 infraspecific forms and hybrids; includes 1 introduced species (*Marsilea quadrifolia*).

Haskins, C. C. A two day's [sic] excursion. Bull. Torrey Club **6**: 123–124. 1876.—List of 24 Filicineae from Big Clifty, Grayson County.

* **McFarland, Frank T.** A catalogue of the vascular plants of Kentucky. Castanea **7**: 77–108. 1942.—Includes (p. 78–80) unannotated list of 63 species, varieties, forms, and hybrids of Pteridophyta, based only on specimens in the Department of Botany

of the University of Kentucky and the Department of Entomology and Botany of the Kentucky Agricultural Experiment Station.

Martindale, Isaac C. Ferns from Rock Castle Springs, Kentucky. Bot. Gaz. **2**: 62–63. 1876.—List of 32 pteridophytes collected by Miss G. H. Rule, with notes on several of the rarer species. (Laurel County.)

LOUISIANA

Total fern flora 61 species (49–12) and 5 infraspecific forms; includes 4 introduced species of Filicineae and 2 of *Selaginella*.

* **Brown, Clair A.**, and **Donovan S. Correll.** Ferns and fern allies of Louisiana. xii, 186 p. 48 fig. (fig. 1, map), front. 23.5 cm. Baton Rouge, 1942.—Botanical explorations, etc.; keyed descriptive treatment of Pteridophyta, with citation of localities and exsiccatae; bibliography.

MAINE

Total fern flora 77 species (50–27) and 73 infraspecific forms and hybrids; includes 1 introduced species (*Marsilea quadrifolia*).

Hazen, Henry H. Survey of ferns in a Maine mountain area. A.F.J. **37**: 79–82. 1947.—Topography, etc.; annotated list of Filicineae. (A peninsula about 1 mile long and one-quarter mile wide, near Rangeley, in Oxford County.)

Malott, Jeanne A. Soil reactions of the pteridophytes of the Megunticook Lake region near Camden, Maine. Butler Univ. Bot. Stud. **9**: 93–107. 1949.—Includes annotated list of 38 species of pteridophytes. (Knox County.)

* **Ogden, Edith B.** The ferns of Maine. Maine Bull. v. 51, no. 3. 128 p. 10 pl., map. 1948. (Univ. of Maine Studies II, 62.)—Brief account of climate, topography, etc., and general account of the uses, etc., of ferns; keyed, descriptive treatment of Filicineae, with citation of localities for all specimens seen and also for those reported in literature; bibliography.

* **Ogden, Eugene C., Ferdinand H. Steinmetz,** and **Fay Hyland.** Check-list of the vascular plants of Maine. Bull. Josselyn Bot. Soc. 8. 1 p. l., 69 p. 1 fig. (map). 1948.—Includes (p. 3–6) tabular list of pteridophytes showing occurrence in each county of the state. (Processed publication.)

Scamman, Edith. Ferns in my pine lot. Maine Naturalist **3**: 18–20. 1923.—Running account of Filicineae [24 species and 3 varieties and hybrids] of Saco and Hollis, York County.

MARYLAND

Total fern flora 74 species (54–20) and 43 infraspecific forms and hybrids; includes 2 introduced species and 1 variety of Filicineae.

See also Delaware (Tatnall).

* **Norton, John B. S.**, and **Russell G. Brown.** A catalog of the vascular plants of Maryland. Castanea **11**: 1–50. 1946. (Reprinted, 1 p. l., 50 p. College Park, Md., 1946.)—Includes (p. 3–5) unannotated list of Pteridophyta, in part with references to the bases for the records.

* **Reed, Clyde F.** County distribution of the ferns and fern-allies in Maryland, Delaware and District of Columbia. Bull. Nat. Hist. Soc. Maryland **13**: 47–54. 1 fig. (map). 1943. (Mimeographed.)—List of 119 species and forms of Pteridophyta, with distribution by counties. There is no statement of the basis for the records; those for the District of Columbia are obviously incomplete. All the plants listed are recorded from Maryand, except nos. 15 and 118.—See also Wagner, Warren H., Jr. Fern field notes in the Washington-Baltimore area. Castanea **11**: 59–60. 1946. (Notes on *Pellaea glabella* and some other species.)

———. Ferns and fern-allies of the Gunpowder River region, Baltimore County, Maryland. Castanea **12**: 76–88. 1947.—Topography, geology, general features of fern flora; annotated list of 55 species and infraspecific forms of Pteridophyta. Covers area within 8 miles of Towson.

MASSACHUSETTS

Total fern flora 76 species (50–26) and 44 infraspecific forms and hybrids; includes 2 introduced species (*Marsilea, Azolla*). (*Salvinia rotundifolia*, listed below, is not counted.)

The latest state list is: Churchill, Joseph R., and others. Reports on the flora of Massachusetts.—I–II. Rhodora **30**: 12–19. 1928; **35**: 351–359. 1933. (A.F.J. **31**: 131. 1941.)—For addition, see Smith, Lyman B. Salvinia rotundifolia in Massachusetts. Rhodora **43**: 556. 1941. (Adventive.)

MICHIGAN

Total fern flora 81 species (55–26) and approximately 45 infraspecific forms and hybrids.

† **Farwell, Oliver A.** Fern notes, III. Ferns and fern allies of the Keweenaw Peninsula, Michigan. A.F.J. **27**: 11–20. 1937.

(A.F.J. **31**: 132. 1941.)—See also his Fern notes, IV: Supplementary remarks on the ferns of the Keweenaw Peninsula, Michigan. l.c. **33**: 8–10. 1943.

MINNESOTA

Total fern flora 72 species (47–25) and 34 infraspecific forms and hybrids.

The latest state lists are: Lyon, Harold L. The pteridophytes of Minnesota. Minn. Bot. Stud. **3**: 245–255. 1903. (A.F.J. **31**: 132. 1941); Moore, J. W., and R. M. Tryon, Jr. A preliminary check list of the flowering plants, ferns and fern allies of Minnesota. 1946. (See below); Rosendahl, Carl O., and Frederick K. Butters. Guide to the ferns and fern allies of Minnesota. 22 p. illus. 1909. (A.F.J. **31**: 132. 1941.)—For addition, see Moore, John W., and Rolla M. Tryon, Jr. A new record for Isoëtes melanopoda. A.F.J. **36**: 89–91. 1946.

*__Moore, John W.__, and __Rolla M. Tryon, Jr.__ A preliminary check list of the flowering plants, ferns and fern allies of Minnesota. 1 p. l., 99 p. 28 cm. Minneapolis, 1946.—Includes (p. 2–5) unannotated list of Pteridophyta. (Mimeographed publication.)

MISSISSIPPI

Total fern flora 36 species (27–9) and 1 infraspecific form. (Includes 2 species from Addenda to Lowe's flora.)

MISSOURI

Total fern flora 55 species (44–11) and 15 infraspecific forms and hybrids.

MONTANA

Total fern flora 57 species (34–23) and 5 infraspecific forms.

NEBRASKA

Total fern flora 27 species (20–7).

NEVADA

Total fern flora 29 species (21–8).

The latest state list is: Tidestrom, Ivar. Flora of Utah and Nevada. Contr. U. S. Nat. Herb. v. 25. 1925. (Pteridophyta, p. 43–52, by William R. Maxon.) (A.F.J. **31**: 133. 1941.)—For addition, see Holmgren, Arthur H. A rare Selaginella from northeastern Nevada. A.F.J. **32**: 86–87. 1942. (*Selaginella selaginoides*.)

NEW HAMPSHIRE

Total fern flora 74 species (47–27) and 67 infraspecific forms and hybrids.

* **Scamman, Edith.** The ferns and fern allies of New Hampshire. Bull. New Hampshire Acad. Sci. 2. 96, [2] p. incl. 18 pl. 1947. Annotated, keyed list of Pteridophyta, with localities for scarcer species; bibliography.—See also Rugg, Harold G. Some New Hampshire ferns. A.F.J. **38**: 92–93. 1948. (× *Asplenosorus ebenoides*).

NEW JERSEY

Total fern flora 78 species (53–25) and 27 infraspecific forms and hybrids.

* **Chrysler, Mintin A.**, and **James L. Edwards.** The ferns of New Jersey including the fern allies. vii, 201 p. 187 fig. (incl. 77 maps), front. 24 cm. New Brunswick, N. J., 1947.—Factors affecting local distribution, etc.; keyed treatment of Pteridophyta, with short descriptions, habitat, general and local range, and for nearly all species a photograph (often in natural habitat) and map showing local range; bibliography, glossary.

NEW MEXICO

Total fern flora 41 species (32–9) and 1 infraspecific form.

* **Wooton, Elmer O.**, and **Paul C. Standley.** Flora of New Mexico. Contr. U. S. Nat. Herb. v. 19. 1915.—Includes (p. 18–30) annotated list of Pteridophyta, with citation of localities; contains a few corrections to their The ferns of New Mexico. A.F.J. **5**: 65–78. *pl. 5–6.* 1915. (A.F.J. **31**: 134.)

NEW YORK

Total fern flora 93 species (62–31) and 60 infraspecific forms and hybrids; includes 1 introduced species (*Marsilea quadrifolia*).

NORTH CAROLINA

Total fern flora 74 species (56–18) and 18 infraspecific forms and hybrids; includes 2 introduced Filicineae.

NORTH DAKOTA

Total fern flora 19 species (12–7) and about 5 infraspecific forms.

OHIO

Total fern flora 74 species (52–22) and 12 infraspecific forms. The latest state lists are Schaffner, John H. The pteridophytes of Ohio. Proc. Ohio Acad. Sci. v. 5, pt. 5, spec. paper no. 16. p. 265–305. illus. 1910. (Contr. Bot. Lab. Ohio State Univ. 52.) (A.F.J. **31**: 136. 1941); Schaffner, Revised catalog of Ohio vascular plants. Bull. Ohio Biol. Surv. **25** (v. 5, no. 2): 87–215. 3 maps. 1932. (Ohio State Univ. Bull. v. 36, no. 9.) (Pteridophyta, p. 99–103.) (A.F.J. **31**: 137. 1941.) (Also Additions . . . I–XIV in Ohio Journ. Sci. v. 33–45, 47. 1933–47.)—For addition, see Bartley, Floyd. Bradley's spleenwort in Ohio. A.F.J. **34**: 62. 1944. (*Asplenium bradleyi.*)

Laughlin, Emma E. Flora of Barnesville, Belmont County, Ohio, and vicinity. Journ. Gray Memorial Bot. Assoc. **10 (1)**: 17–18. 1942.—Consists of a partly annotated list of 32 species and 1 variety of Pteridophyta from 20 miles around Barnesville, including parts of Belmont, Guernsey, and Monroe Counties. (Processed publication.)

Proctor, George R. Check list of the ferns of Washington County, Ohio. Journ. Gray Memorial Bot. Assoc. **10 (2)**: 3–4. 1943.—Alphabetical list of 41 (i.e. 42) species and forms of Pteridophyta, with localities and occasional annotations. (Processed publication.)

———. Fern census of a city block. A.F.J. **32**: 70–71. 1942.—List of 21 species of Pteridophyta found growing in a thickly built residential block in Marietta, Washington County, Ohio; of these 8 were spontaneous and 13 were planted only.

OKLAHOMA

Total fern flora 54 species (45–9).

OREGON

Total fern flora 68 species (45–23) and 4 infraspecific forms.

Baker, William H. Ferns of Fairview Mountain, Calapooya Range, Oregon. A.F.J. **38**: 89–91. 1948.—Geology, etc.; annotated list of Polypodiaceae; short bibliography. (Lane County.)

PENNSYLVANIA

Total fern flora 78 species (56–22) and 78 infraspecific forms.

* **Canan, Elsie D.** A key to the ferns of Pennsylvania. Includes a non-technical key for identification of each of the fifty-nine species found in the state; directions for use of the key; an outline for aid in identification of ferns by sterile fronds alone; distribution of species throughout the state; and a list of ferns found in the vicinity of Johnstown, Cambria County. 3 p. l.,

112 p. incl. 61 pl. 22 cm. Philadelphia, 1946.—Annotated key to Filicineae, and plate of each species; additional key, based on sterile fronds; grouping of species according to abundance; systematic list of species; glossary; indices; annotated list of species; list of Filicineae of Johnstown and vicinity. No authorities for botanical names are given.

Dix, William L. The ferns of Wayne County, Pennsylvania. A.F.J. **37**: 100–110. 1947.—Topography, geology, botanical explorations; annotated list of Pteridophyta.

† **Gruber, Calvin L.** Fern and fern allies in the Kutztown-Fleetwood area, Berks County, Pennsylvania. A.F.J. **30**: 41–49, 89–98. 1940. (A.F.J. **31**: 138. 1941.)—See also his Additional ferns in the Kutztown-Fleetwood area, Pa. l.c. **32**: 151–152. 1942.

* **Wherry, Edgar T.** The ferns and lycosphens of Pennsylvania. Bartonia **21**: 11–37. *pl. 1, f. 2.* 1942.—Annotated list of Pteridophyta, with localities for rarer species. Authorities for botanical names are not given. The name ''lycosphen,'' here first published, is intended to replace ''fern ally.''—See also his The discoverers of new Pennsylvania ferns. A.F.J. **32**: 148–149. 1942. (Names of collectors and references to published records for ferns recorded as new to Pennsylvania in the above paper.)—Also his Lycopodium sabinaefolium in Pennsylvania. l.c. **32**: 111–113. 1942.

RHODE ISLAND

Total fern flora 57 species (42–15) and 16 infraspecific forms and hybrids.

Palmer, Ernest J. Ferns and fern allies of Cumberland, Rhode Island. A.F.J. **37**: 33–38. 1947.—Topography, etc.; annotated list of 40 Pteridophyta (including 37 species.) (Providence County.)

SOUTH CAROLINA

Total fern flora 66 species (51–15) and 1 hybrid; includes 3 introduced Filicineae.

The latest state list is: Matthews, Velma D. The ferns and fern allies of South Carolina. A.F.J. **30**: 73–80, 119–128. map. 1940–41; **31**: 4–11. 1941. (A.F.J. **31**: 139. 1941.)—For addition, see Blomquist, Hugo L. Asplenium monanthes in South Carolina. A.F.J. **38**: 171–176 incl. pl. 14–15. 1948.

Hunt, Kenneth W. Ferns of the vicinity of Charleston, South Carolina. Charleston Museum Leaflet 17. 15 p. 1942.—Annotated list of 31 species and varieties of Pteridophyta within a radius of 25 miles of Charleston, with citation of localities and a key to the species; bibliography. (In Berkeley, Charleston, and Dorchester Counties.)

SOUTH DAKOTA

Total fern flora 37 species (25–12) and 1 hybrid.

TENNESSEE

Total fern flora 61 species (50–11) and 15 infraspecific forms and hybrids.

The latest state lists are: Anderson, William A., Jr. A list of Tennessee ferns. A.F.J. **20**: 143–150. 1930 [1931]; **21**: 11–20, 64–71. 1931. (A.F.J. **31**: 139. 1941.) (Filicineae only); Gattinger, A. The flora of Tennessee. 1901. (See below.)—See also Knight, William A. Woodsia scopulina in Tennessee. A.F.J. **23**: 27–28. 1933.

Frick, T. A. Some ferns of Claiborne County, Tennessee. Journ. Tennessee Acad. Sci. **21**: 266–267. 1946.—Topography, etc.; running account of Filicineae including partial list of known species.

* **Gattinger, Augustin.** The flora of Tennessee and a philosophy of botany. Nashville, 1901.—Includes (p. 27–31) annotated list of Pteridophyta.

* **Shaver, Jesse M.** Some general notes on ferns. Journ. Tennessee Acad. Sci. **17**: 310–336. fig. 1–9 (fig. 9, map), front. 1942.—The filmy and polypody ferns in Tennessee. l.c. **18**: 215–222. fig. 10–13 (incl. maps). 1943; **19**: 167–174. fig. 14–20 (incl. maps). 1944.—Some notes on the bracken and maidenhair ferns of Tennessee. l.c. **19**: 203–227. fig. 21–38 (incl. maps). 1944.—Some notes on the Tennessee lipferns [Cheilanthes]. l.c. **19**: 306–322. fig. 39–47 (incl. maps). 1944.—Some notes on Tennessee cliffbrakes, chainferns, and the American hartstongue. l.c. **20**: 174–202. fig. 48–61 (incl. maps). 1945.—Tennessee spleenworts. [I]–II. l.c. **20**: 243–260, 326–362. fig. 62–91 (incl. maps). port. 1945.—The walking spleenwort, the walkingfern, the narrowleaf spleenwort, and the silvery spleenwort. l.c. **21**: 143–177. fig. 92–109 (incl. maps). 1946.—The southern lady fern, the New York fern, and the marshfern. l.c. **21**: 297–318. fig. 110–120 (incl. maps). 1946; **22**: 255–256. fig. 121 (map). 1947.—A study of Tennessee ferns belonging to the genus Dryopteris. l.c. **22**: 257–302. fig. 122–143 (incl. maps). 1947; **23**: 111–119. fig. 144–147 (incl. maps). 1948.—A study of Tennessee ferns belonging to the genera Phegopteris, Polystichum, and Cystopteris. l.c. **23**: 123–130, 258–274. fig. 148–160 (incl. map).

1948; **24:** 179–194. fig. 161–168 (incl. maps). 1949.—General account of ferns (in 1942 paper); treatment of Tennessee ferns, group by group, with discussion of occurrence and diagnostic features, very detailed descriptions, account of local variations and bibliography for each species, also maps showing range, line drawings including details, and in most cases habit photographs; altogether the most elaborate treatment of the family in American literature. Still in process of publication.

TEXAS

Total fern flora 103 species (82–21) and 15 infraspecific forms and hybrids; includes 3 naturalized or established Filicineae.

* **Correll, Donovan S.** A preliminary survey of the distribution of Texas Pteridophyta. Wrightia **1:** 247–278. fig. 14–17 (fig. 14–16, maps). 1949.—Previous work, botanical regions, local distribution, table showing distribution by botanical regions; annotated list of known pteridophytes, with habitat and distribution; bibliography.

UTAH

Total fern flora 53 species (39–14) and 1 infraspecific form.

* **Flowers, Seville.** Ferns of Utah. Bull. Univ. Utah v. 35, no. 7 (Biol. Ser. v. 4, no. 6). 87 p. incl. 164 fig., map. 1944.—General morphology, local ecology and distribution; annotated, keyed, descriptive flora of Pteridophyta with citation of exsiccatae and localities.—See also his A new Selaginella from southwestern Utah. A.F.J. **39:** 83–86 incl. *pl. 7.* 1949. (*Selaginella utahensis.*)

VERMONT

Total fern flora 81 species (53–28) and 109 infraspecific forms and hybrids.

VIRGINIA

Total fern flora 77 species (58–19) and 34 infraspecific forms and hybrids.

See also Tatnall, R. R., under Delaware.

* **Massey, Arthur B.** The ferns and fern allies of Virginia. Bull. Va. Polytechnic Institute v. 37, no. 7. 110 p. 21 fig. 1944. (Cover title, Virginia ferns and fern allies.)—Fern structure, cultivation, and collection, etc., check list of species and forms; annotated descriptive list of Pteridophyta, with detailed citation of specimens; key to species and forms; bibliography, list of herbaria cited. Includes 110 species, varieties, forms, and hybrids.—See also

Wagner, Warren H., Jr. Botrychium multifidum in Virginia. A.F.J. **36:** 117–121 incl. *pl. 9.* 1946.

WASHINGTON

Total fern flora 72 species (43–29) and 13 infraspecific forms.

WEST VIRGINIA

Total fern flora 68 species (53–15) and 22 infraspecific forms and hybrids.

The latest state lists are: Brooks, Maurice G. The pteridophytes of West Virgina. West Virginia Univ. Bull. ser. 39, no. 2. 60 p., 16 pl. 1938. (Contr. Herb. West Virginia Univ. no. 3) (A.F.J. **31:** 142. 1941); Core, E. L. A catalogue of the vascular plants of West Virginia. 1940. (See below.)—For additions, see Legg, William C., and M. G. Brooks. New Botrychium finds in West Virginia. A.F.J. **33:** 140–141. 1943. (*Botrychium simplex* var. *tenebrosum.*)—Also Hunnewell, Francis W. Botrychium matricariaefolium in West Virginia. Castanea **13:** 93. 1948.

* **Core, Earl L.** A catalogue of the vascular plants of West Virginia. Castanea **5:** 31–73. 1940.—Includes (p. 33–34) unannotated list of Pteridophyta (90 species, varieties, and forms), in part with references to the bases for the records. See also Additions . . . I–VI. In Proc. W. Va. Acad. Sci. v. 15–20. 1942–48.

WISCONSIN

Total fern flora 77 species (52–25) and 29 infraspecific forms and hybrids.

* **Breakey, Edith W.,** and **Ruth I. Walker.** Preliminary reports on the flora of Wisconsin. XII. Polypodiaceae. Trans. Wisc. Acad. Sci., Arts & Lett. **26:** 263–273. 30 figs. (maps). 1931.—Annotated list, the range of each species shown on a small map.

WYOMING

Total fern flora 34 species (22–12) and 1 infraspecific form.

The latest state lists are: Hanna, Leo A. Distribution of the ferns of Wyoming. A.F.J. **22:** 1–11. map. 1932. (A.F.J. **31:** 143. 1941); Porter, Cedric L. The pteridophytes of Wyoming. Torreya **32:** 116–118. 1932. (A.F.J. **31:** 143. 1941.)—For addition, see Holmgren, Arthur H. A rare Selaginella from northeastern Nevada. A.F.J. **32:** 86–87. 1942. (*Selaginella selaginoides,* recorded also from Wyoming.)

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ERRATA

Volume 39, Number 3.

Cover, Table of Contents, line 5: For "Utha," read "Utah."

Page 85, line 18: for "South of St. George," read "on dry face of Lady Mountain, Zion National Park."[1]

Page 85, line 18 and 19: Delete: "in wash bottom."

Page 85, line 25: For "20," read "31."

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[1] In the original description of *Selaginella utahensis* the locality for the type is incorrect as given. Due to a clerical error, part of the habitat and locality data was copied from the wrong line in the field catalogue at the time when the label for one of the sheets was made.—Seville Flowers.

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A QUARTERLY DEVOTED TO FERNS

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EDITORS
C. V. MORTON
R. C. BENEDICT IRA L. WIGGINS

CONTENTS

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American Fern Journal

Vol. 40 April–June, 1950 No. 2

Preliminary Reports on the Flora of Georgia—III. The Distribution of Seven Lycopsida

Wilbur H. Duncan

Recent vegetative surveys have led to the discovery of range extensions for seven Lycopsida. The species are *Lycopodium alopecuroides* L., *L. appressum* (Chapm.) Lloyd & Underw., *L. carolinianum* L., *L. lucidulum* Michx., *L. Selago* L., *Selaginella arenicola* Underwood, and *S. tortipila* A. Br. Some of the extensions are consistant with the distributional information previously reported. Others are quite a surprise, especially in the case of first records for the Piedmont for at least two species that have been thought to be confined to the Coastal Plain throughout their range.

LYCOPODIUM

Small (1938) gives general distributional information for the five species included here. Otherwise there appear to be little published data on the distribution of these species. Some data may be found in publications such as Blomquist's "Ferns of North Carolina," but there is little information for the state of Georgia. Accordingly, specific information on distribution in Georgia should be of value.

In connection with a vegetative survey of the Allatoona Dam Reservoir area, near Cartersville, Georgia, I came upon some abandoned surface graphite mines. The broad floor of one of these mines, now thinly popu-

[Volume 40, No. 1, of the Journal pp. 1–168 was issued May 1, 1950.]

lated with pines, was poorly drained and apparently remained rather moist, partly because of seepage from the base of the walls which practically surround the floor. The habitat appears much like many Coastal Plain situations of a much larger extent.

I was much surprised to find in the mine a large colony of *L. alopecuroides* (Bartow Co.: 1¾ miles east of Emerson, July 19, 1948, *Duncan* 8545). This station is about 80 miles north-northwest of the nearest station in Pike County, where R. M. Harper (2249, Gray Herb.) collected it. The colony in the mine is undoubtedly a recent migration inasmuch as the mines were abandoned only some 30 or 40 years ago. It might be profitable to search for other stations in the area with a view of determining whether or not migration was probably from a short or a long distance. Small (1938) says of this species, "Its range lies in the Coastal Plain, from Florida to Mississippi and New York." Was Small unaware of Harper's earlier Pike County collection, or did he consider Pike County to be in the Coastal Plain, even though it is at least 20 miles inside the Piedmont? The answer to this question is of less importance now that the range is extended 100 miles into the Piedmont from the Coastal Plain.

Two recent collections of *L. appressum* extended the range of this species in Georgia into the Piedmont. (Forsyth Co.: October 10, 1948, *McDowell & Venard;* Clarke Co.: October 29, 1948, *Duncan* 9062A). This species is abundant in the Coastal Plain of the southeast and is known locally in the adjacent Piedmont. No previous records in Georgia for the latter Province are reported. The Forsyth County record is 125 miles north of the most northern previously known record in Peach County and is about 1,000 feet higher in elevation (1,450 feet). The colony is in a seepage area in an open pine-oak woods on the southeast side of Sawnee Mountain, 1½ miles N.N.W. of Cumming. The character of the habitat is such that the colony could have been there for a long, long time.

Another extension of range is that of *L. carolinianum* to Clarke County (moist grassy flats in open pine woods at edge of City Water Reservoir north of Athens, October 29, 1948, *Duncan* 9062B). This species has previously been reported only in the Coastal Plain at low elevations. The range is now extended into the Piedmont and to an elevation of about 750 feet. The nearest known stations are 140 miles to the southwest (Muscogee Co.: *Eyles* 2758) and 125 miles to the southeast, Emanuel County, reported by Harper (1906). The character of the ground is such that before the Reservoir was completed in 1918 the area would not have been suitable for growth of this *Lycopodium.* It must have come in within the last 20 years. Much speculation has arisen concerning the agent of dispersal, the most frequent suggestion being that some shore bird, e.g. a sandpiper, carried spores to the edge of the lake.

L. lucidulum is reported by Small (1938) as ranging southward to South Carolina and Tennessee. No definite reference to Georgia is made. Blomquist (1934) includes Georgia in its range but gives no details. Several Georgia collections in the University of Georgia Herbarium throw considerable light upon the distributional limits in the southeast. The earliest collection is from Rabun County (Spring at Lake Tugaloo, Tallulah Falls, August 7, 1936, *J. B. Whitney, Jr.*). This is at an elevation of about 900 feet, the lowest elevation for Georgia and the southernmost station for the species. Other collections are from Union County (Brasstown Bald, 4650 feet, July 20, 1947, *Duncan* 7719) and Towns County (Brasstown Bald, 4430 feet, April 18, 1937, *Pyron & McVaugh* 1561; north slopes of Hightower Bald, 4450 feet, August 4, 1946, *Duncan* 6878).

The last species of *Lycopodium* to be discussed, *L. Selago,* has been reported by Small (1938) from as far south as North Carolina and Tennessee. Matthews (1941) reports the species for South Carolina at an elevation of 2,500 feet. The Georgia stations are both in Rabun County (Rabun Bald, about 4000 feet, July 26, 1936, *Pyron & McVaugh* 889; at bottom of rock bluff on sides of ravine south of Glade Mountain, about 2700 feet, March 19, 1949, *Duncan* (with *Venard & McDowell*) 9086).

SELAGINELLA

Clausen's (1946) summary of distributional records for certain species includes the two species to be discussed in this paper. He stated that "*Selaginella arenicola* is known from the Coastal Plain of Georgia and Florida." My collection of this species from Paulding County (*Duncan* 8683) in the Piedmont is 90 miles north of the closest station which is in Muscogee County, Georgia. All previously known stations are from the Coastal Plain. In order to verify my determination, a duplicate specimen was sent to Dr. Clausen. His reply of August 23, 1948 was, "The *Selaginella* is *S. arenicola,* the first definite record from well inside the Piedmont Province . . . ." The plants were found in dense clumps in shallow pockets of soil in depressions on granite rocks at Mulberry Rock, 9¾ miles southwest of Dallas. The elevation is about 1,250 feet, which is almost a thousand feet above any previously known station.

S. tortipila is reported as occurring in Rabun County by Wherry (1936), along west bank of Chattooga River one mile south of Pine Mountain Post Office. Clausen (1946) reports this species from Columbia and Warren Counties but does not include Rabun. I am able to confirm Rabun County as being included in the range of the species (on bare rock bluff overlooking ravine along Reed Creek, south of Glade Mountain, 2,700 feet, *Duncan* 9084; on steep rock exposure southeast of Glade Mountain, elevation about 3,300 feet, *Duncan* 9339). The last collection indicates that the altitudinal range in Georgia of this species is from about 300 to 3,300 feet.

It would seem that *Selaginella arenicola* at Mulberry Rock in Paulding County is a relic of an old flora—perhaps as far back as the Eocene—and that the present population on the Coastal Plain migrated from the Piedmont. This may also be true of the *Lycopodium appressum* in Forsyth County. If the details of habitat were not known for the *L. alopecuroides* from Bartow County and for the *L. carolinianum* from Clarke County, then these stations might have been considered erroneously as being relic, too. These are but two examples of many where an interpretation of distribution on a geographical basis only might be in error.

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WHERRY, E. T. 1936. Observations on Selaginella tortipila. Castanea **1**: 67.

UNIVERSITY OF GEORGIA, ATHENS, GEORGIA

A New Form of Lorinseria

J. E. BENEDICT, JR.

Although the fronds of *Lorinseria areolata* and *Onoclea sensibilis* are similar in general aspect, they can usually be told apart at a distance by the undulate to deeply lobed margins of the primary lobes of the *Onoclea*. Not so, however, in a large colony found by the writer while on a visit to his son in Hampton, Virginia, last May. The fronds in this colony had the lobing of *Onoclea*, but showed by their alternate pinnae, finely serrate margins and chain-like venation along the principal veins that they were really *Lorinseria*. The aspect and character noted are brought out in the accompanying figure, kindly drawn by Mr. Joseph A. Devlin. No fertile fronds were seen. The following formal name was suggested by Dr. E. T. Wherry.

LORINSERIA AREOLATA (L.) Presl forma **onocleoides** J. E. Benedict, f. nov.

A f. *typica* pinnis profunde pinnatifidis, lobis obtusis, usque ad 8 mm. longis et 6 mm. latis differt.

Differs from the typical form in having the pinnae all deeply lobed, the lobes obtuse, up to 8 mm. long and 6 mm. broad.

Type in the U. S. National Herbarium, no. 1918314, collected one mile due west of the village of Aberdeen Gardens, Elizabeth City County, Virginia, in a loblolly-pine (*Pinus taeda*) woods, May 30, 1949, by J. E. Benedict, Jr. (no. 5540). The station is 4 miles due north of Newport News, which, however, is in another county.

WASHINGTON, D. C.

LORINSERIA AREOLATA F. ONOCLEOIDES

The Net Fern in Florida

MARY L. SINGELTARY

After the September storm of 1947, I was quite excited over finding what to me was an unusual fern growing on the upper part of the side wall of a roadside drainage ditch near Kissimmee, Florida. I identified the fern as *Dicranopteris flexuosa* (Schrad.) Underw. and this determination has been confirmed by H. L. Blomquist of Duke University. So far as I have been able to determine, this is the first record of this fern for Florida. According to Small[1] the only record of this fern for the United States is from Mon Louis Island, Alabama, where it was discovered in 1913.

Having found one plant, I looked around for others and found several large dead leaves, indicating that the fern had grown on top of the bank several feet from the edge of the ditch for at least a year or more. A pine tree had fallen over the ditch at this spot and it seemed that the branches and needles had choked the fern on the bank so that the rootstock had been forced to grow towards the ditch. The old leaves were found in a tangled mass of scrub palmetto and dead pine branches. The fern seems to be persisting on the ditch wall, for it has one fair-sized leaf and about 8 to 10 small ones, but the station is a precarious one, being exposed to storms and chances of high water.

The location of this station is about 8 miles from Kissimmee, county seat of Osceola County, in the central part of Florida. This county lies at about Long. 81° W. and Lat. 28° N. The distance between this station and the one in Alabama is approximately 435 miles. Both stations are in pineland, but the soil of the Florida station is sandy instead of clayey as in the Alabama station.

KISSIMMEE, FLORIDA.

[1] Ferns of the Southeast, 329–330, 1938.

Dicranopteris flexuosa

Notholaena Copelandii, a Newly Recognized Species of the Texano–Mexican Region

CARLOTTA C. HALL[1]

Botanical collecting in the arid Southwest is a far less strenuous undertaking today than it was in the nineteenth century when travel was mostly by trail and afoot or horseback. As a result of more roads and better transportation, herbaria are now receiving many specimens of the xerophytic ferns of that region, so that our understanding of the species occurring there is much improved. Eminent fern students of those earlier days had few specimens and those often in such curled-up, poor condition that it is not surprising the species did not stand-out as more definite entities. The farinose Notholaenas were usually determined as *Notholaena cretacea* Liebm. or as *Notholaena candida* (Mart. and Gal.) Hooker. With the large United States National Herbarium at hand, Dr. William R. Maxon straightened out much of the resulting confusion in this and other fern groups of western North America. There is, however, an entity, and to me a striking one, which has apparently always been determined as *N. candida,* or not named at all, and which Dr. Maxon seems to have overlooked. This fern has a unique aspect, distinguishing characters and a range distinct and separate from that of *N. candida.*

Notholaena candida (Mart. and Gal.) Hook. (*Cheilanthes candida* Mart. and Gal.) was founded on Galeotti's collection no. 6442. In the discussion after the

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[1] Carlotta C. Hall died very suddenly and unexpectedly on December 6, 1949, at the home of her daughter, Mrs. Robert S. Niccolls, of Ann Arbor, Michigan. At the time of her death Mrs. Hall had completed work on the present paper and was engaged in final revision of the manuscript, which was completed by Dr. Rogers McVaugh. [Ed.]

technical description[2] the authors state that the specimens came from the Valley of the Rio Grande de Lerma north of Guadalajara, that the fern does well on dry volcanic rock exposed to the rays of the sun and that it ranges over western Mexico from 2500 to 4000 feet altitude. The type has not been available for study, but an inquiry to the Jardin Botanique de l'État, Brussels, has brought the information that the herbarium there contains three sheets of Galeotti's no. 6442, as follows: (1) Type sheet, "Mex. (sur les rochers près Guadalaxara)"; (2) "Mexico, province de Jalisco, hauteur 3–5000′, rarissima"; (3) "Mexico, province de Oaxaca et Jalisco hauteur 3000 ad 5000 p., rarissima". Mr. C. A. Weatherby, who had studied the type and also a specimen of Galeotti's no. 6442 in the Herbarium Hookerianum at Kew informed me that the Kew specimen (from "Oaxaca") "is a good match for the type." I have studied the Kew specimen, which consists of two fronds broken off near the blade. It is badly curled but shows the characters of this fern of western Mexico as it is represented by other collections in various herbaria.

The range of *Notholaena candida* is from Honduras and Guatemala northward to Hidalgo, Michoacán, Sonora and the Cape Region of Baja California. The blade is white- to light-yellow-farinose beneath, short- to elongate-triangular, and tapers to a short tip. The pinnae taper from their base to an attenuate tip. The lowest pinnae, and often one or two pairs immediately above, are inequilateral. Three to five inferior pinnules are always elongate, graduating in length outward from the basal pinnule which is longest (2 to 4 cm.). They are also lobed, pinnatifid or sometimes pinnate, usually with short, broad, obtuse, adnate segments. Segments of other pinnae are usually more or less lobed or crenate.

[2] Memoire sur Les Fougères du Mexique, p. 74.

NOTHOLAENA CANDIDA (COPELAND 96)

The rootstock-scales may be toothed near the tip, but are scarcely at all ciliate.

The species with which this paper is concerned, which seems heretofore to have been confused with *N. candida,* we propose to name in honor of Dr. Edwin B. Copeland, generous mentor of many fern students.

NOTHOLAENA **Copelandii** Carlotta C. Hall, sp. nov.; lamina inferne farinosa, 8–16 cm. longa, 5–9 cm. lata, ovata vel lanceolata, sursum abrupte in apicem angustam 3–4.5 cm. longam contracta; pinnulis infimis basiscopicis pinnarum infimarum valde elongatis 3–4 cm. longis profunde pinnatifidis vel etiam pinnatis; pinnis alteris aequilateralibus, supra mediam gradatim angustatis; segmentis obtusis vel acutis, anguste elongatis, plerumque integris margine reflexo; venis liberis, furcatis vel bifurcatis; sporangiis tantum binis, submarginalibus ad apices venarum; sporis trigonis, fuscis, asperis; rhizomate brevi, nodoso, paleis obscuris, margine lato brunneo ciliato, apice brevi.

Fronds 12 to 35 cm. long, clustered at the ends of short branches of a compact densely scaly rootstock; scales dark, with a rather broad amber border of small irregular cells, toothed, especially toward the tip, ciliate at least when young; stipe black, slender, terete, smooth except for the scaly base, usually much longer than the blade; rachis black, grooved on the ventral side; blade bipinnatifid to bipinnate, more or less white-glandular above, especially when young, copiously white-farinose beneath, 8–16 cm. long (from base of rachis), 5–9 cm. wide, ovate, reduced abruptly to a narrowed tapering tip 3–4.5 cm. long; pinnae sessile, equilateral and tapering from base to tip, except the basal pair which have one (rarely two) greatly elongate (usually 2–4 cm.), lanceolate, deeply pinnatifid inferior basal pinnules; segments adnate, acute or obtuse, mostly entire, narrowly oblong, about 5–8 mm. long, 2 mm. broad or less; sporangia large, 1–3 at the tip of the veins; indusium wanting.

Type in the University of California Herbarium, no. 122910, collected on calcareous ledges in the Sierra

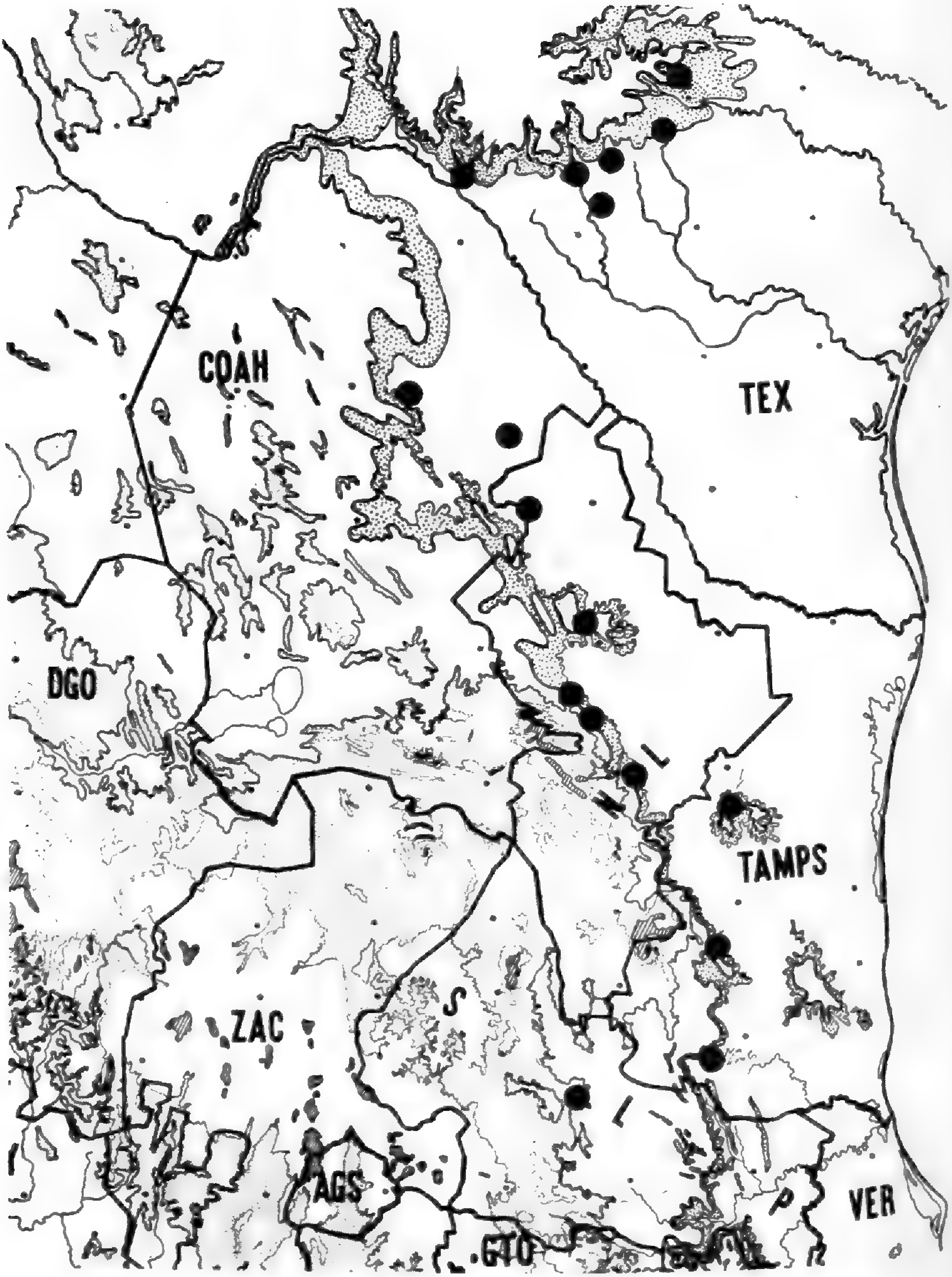
NOTHOLAENA COPELANDII (TYPE)

Madre Oriental near Monterrey, Nuevo León, Mexico, by C. G. Pringle (no. 2038).

N. Copelandii is endemic in northeastern Mexico in the Sierra Madre Oriental from about 22° N. latitude, just south of the Tropic of Cancer, to about 32° N. latitude in Texas on the northeast side of the great northerly bend in the Rio Grande. It ranges from 1000 to 2000 feet altitude. Its habitat is limestone which seems to be an important determinant for its distribution in this area. In Texas it is reported to occur "on high limestone hills growing on exposed slopes and ledges." The obvious characters which distinguish it from *N. candida* are: (1) an abrupt reduction of the broad blade to a long narrow tip of mostly entire segments (*N. candida* graduates into the tip); (2) typically the lowest pinnae have each a single well developed elongate pinnatifid inferior basal pinnule (of 189 fronds examined, 144 fronds had only a single elongate inferior pinnule to each basal pinna. *N. candida* has three to five elongate inferior pinnules.); (3) upper pinnae mostly equilateral and usually keeping the same width to or beyond the middle (in *N. candida* they graduate from the base to an attenuate tip); (4) slender segments, mostly less than 2 mm. wide in dried specimens and margins typically entire (in *N. candida* they are more than 2 mm. wide and usually crenate or lobed); (5) margin of the young rootstock scale ciliate and toothed (scales of *N. candida* toothed, but mostly lack cilia). There is typically one large sporangium at the broad tip of each branch of the free, forked veins. The spore is finely rough and tetrahedral. The species is exindusiate.

It was a specimen *N. Copelandii*, collected on the Mexican Boundary Survey, which was used for illustrating *N. candida* in D. C. Eaton's "Ferns of North America."

It has seemed best to assign this new species to *Notho-*



DISTRIBUTION OF NOTHOLAENA COPELANDII. MOST OF THE LOCALITIES LIE IN THE ZONE (INDICATED BY HEAVY STIPPLING) BETWEEN 500 METERS AND 700 METERS.

laena, defining that genus according to the interpretation of Dr. Maxon, who took *Acrostichum Marantae* L. as the type-species. Dr. E. B. Copeland, who considers *Notholaena distans* R. Br. to be the type species, also considers *Notholaena* and *Cheilanthes* to be congeneric, the latter name having priority. Most fern students who know *Cheilanthes* and *Notholaena* have recognized that there are several distinct groups of species in the assemblage. Until these smaller groups are adequately worked out and defined one must of necessity add any new or controversial species to the group that contains its nearest allies, if this can be determined. As the present new species is a *Notholaena* according to the traditional interpretation, it is here described as a member of that genus pending further work on the group and general acceptance of Dr. Copeland's view of the inclusive *Cheilanthes*.

The following collections have been examined from the following herbaria: E. B. Copeland (C), Dudley Herbarium, Stanford University (DS), Chicago Natural History Museum (F), University of Michigan (Mich), University of California, Berkeley (UC), United States National Herbarium (US).

COAHUILA: Near Muzquiz, *Marsh* 351 (US); Juraz [Juárez] *Palmer* 1380 V, AA and X (US).

NUEVO LEÓN: Near Monterrey, *Pringle* 2038 (F, UC), 13722 (Mich, US), *Copeland* 96 (C, UC, US), *Tharp* 1795 (US), *Fisher* 3 (DS, US), *Orcutt* 1147 (US); Guajuco [Villa Santiago], *Palmer* 1380 (US); Valley of Río San Juan, east of Villa Santiago, *Johnson & Barkley* 16137M (F); south of Villa Santiago, *Pennell* 16949 (US); Lampazos, *Mary Taylor* 346d (DS); 17 miles north of Linares, *R. Storer* 72 (UC); Mun. Sabinas Hidalgo, *W. C. Leavenworth* 62 (F).

TAMAULIPAS: Vicinity of Victoria, *Palmer* 191 (F, UC, US); *Fisher* 3323, 3325 (US), *Runyon*, s.n. (F); vicinity of Ocampo, *Stanford et al* 1067 (DS, UC, US); Sierra de San Carlos, near San Miguel, *Bartlett* 10586 (F, US).

SAN LUIS POTOSÍ: Minas de San Rafael, *Purpus* 5484 (F, US), 4877 (F, UC, US), 4876 (C).

TEXAS: Western Texas, *Nealley* in 1890 (F); Valley of Río Grande below Doñana, *Parry et al* 1586 (US); vicinity of Devils River, *Rose* 17968 (US), *Vernon Bailey* 755 (US); Canyon of Sabinal, *Wright* in 1851–52 (US), *Reverchon* 1626 (DS, F, UC, US); Western Texas, *C. Wright* 820 (UC, US). Uvalde County: Round Mountain, *R. J. Hill* 72 (US), *McAllister* 2163 (US); Real County: Leakey, high hills, *E. J. Palmer* 10145 (DS, US); Valverde County: *J. R. Moorhead* 3 (US); north of Del Rio, *Jones* 8414 (DS, UC); Gillespie County: Cedar Mountain, *G. Jermy* 349 (US); Edwards County: Cedar Creek near Barksdale, *E. J. Palmer* 11011 (DS, US); Kerr county: 12 miles southwest of Kerrville, *McVaugh* 7666 (Mich).

The related *Notholaena candida* is known from the following collections:

BAJA CALIFORNIA: Sierra El Taste, *Brandegee* (UC); Sierra de la Laguna, *Brandegee* 657 (UC), *Hammerly* 282 (US).

SONORA: Caramechi, Río Mayo, *Gentry* 1198 (F); Alamos, *Palmer* 341 in 1890 (F, US); between Nogales and Arispe, *Druery* (US).

CHIHUAHUA: "S.W. Chichuhua" [vicinity of San Miguel, near Batopilas], *Palmer* 82 in 1885 (US); mountains of southern Chihuahua, R. N. *Zingg* 6 (F); Río Bonito, *LeSueur* 2021 (UC).

SINALOA: San Ignacio, Lodiego, *Palmer* 1569 (US), 1570 (US), 1575 (US), *Salazar* 612 (US).

DURANGO: Sianori, *Ortega* 5311 (US), *García* 650 (US).

JALISCO: Barranca de Oblatos, near Guadalajara, *Barnes & Land* 141 (F, US), *Pringle* 11786 (F, Mich, US), *M. E. Jones* (US), *Rose & Painter* 7412 (US); about 9 miles south of Autlán, *R. L. Wilbur* (Mich); La Quemada, *Israel* (US).

COLIMA: San Marcos, *M. E. Jones* 516 (US).

MICHOACÁN: Mun. de Apatzingán, *Leavenworth & Hoogstraal* 1713 (F).

GUERRERO: Pino, Distr. Mina, *Hinton* 9628 (US).

MORELOS: Near Cuernavaca, *Rose & Painter* 6924 (US), *Rose & Rose* 11060 (US); Xochiltepec, *Lyonnet* 2676 (US).

MEXICO: Cañitas, Distr. Temascaltepec, *Hinton* 7395 (US).

OAXACA: Tomellin Cañon, *Rose & Rose* 11334 (US).

HIDALGO: Jacala, *V. H. Chase* 7415 (F),[3] *Fisher* 37107 (US).

[3] Doubtful, according to Mrs. Hall's notes. [Ed.]

PUEBLA: Near Tehuacán, *Rose et al.* 9949 (US); San Luis Tultitlanapa, near Oaxaca, *Purpus* 3145 (F).

VERACRUZ: Orizaba, Ojo de Agua, *Copeland* 95 (UC).

GUATEMALA: Dept. Guatemala, *Standley* 59221 (F); northeast of Jutiapa, *Standley* 75929 (F); near Jalapa, Dept. of Jalapa, *Standley* 77094 (F); Santa Rosa, Dept. of Santa Rosa, *Maxon & Hay* 3368 (US); near Salamá, Dept. Baja Verapaz, *Cook* 270 (US).

HONDURAS: Sabana Grande, Dept. Morazán, *J. V. Rodriguez* 3259 (F).

UNIVERSITY OF CALIFORNIA, BERKELEY, CALIFORNIA.

Pilularia americana in Kansas

R. L. McGREGOR

For several years the author has examined likely looking habitats in the state of Kansas in search of *Pilularia americana* A. Br. Though many lakes, ponds and marshy areas have been visited this pteridophyte was not found until recently.

On September 3, 1949 while collecting in a sand dune region three miles north of Hutchinson, Reno County, Kansas, several large colonies of *Pilularia americana* were found on the margins of small permanent ponds located among stabilized sand dunes. The plants were growing in very fine sand in which only a trace of sediment could be seen.

At first glance, the colonies of *Pilularia americana* looked like the usual marginal growth of young sedges, particularly those of the genus *Eleocharis*. However, on closer observation the circinate condition of the developing simple, awl-shaped, bladeless leaf could be seen. Upon digging out a few of the plants the numerous small sporocarps became evident. Strand plants formed a marginal growth approximately two feet wide on the west sides of the ponds. Submerged plants were found to a depth of about eighteen inches and had produced few sporocarps in comparison with the stranded plants.

The mature leaves of the strand plants averaged one and a half inches in length and were blackened at the tip. This latter character, due to death of the tissue, was a help in distinguishing the plants from the ever-abundant sedges. Mature leaves of the submerged plants averaged three inches in length and were much more scattered along the rhizome than were the leaves of the strand plants.

All the sporocarps were borne on stalks from one to three millimeters long. Their diameter varied from two to three millimeters. Young sporocarps were white but changed to reddish-brown as they matured and finally became black.

The only other pteridophytes found in the region were a few widely scattered specimens of *Equisetum kansanum* J. H. Schaffner and a great abundance of *Marsilea vestita* Hook. and Grev.

Broun in his Index to North American Ferns lists *Pilularia americana* as occurring from southern California to Oregon and isolated in western Arkansas and in central Georgia. The station reported in this paper from south-central Kansas therefore adds another isolated locality to the known distribution of this plant. The distribution, however, could probably be greatly extended if collectors searched a little more for this interesting pteridophyte.

DEPT. OF BOTANY, UNIVERSITY OF KANSAS.

Recent Fern Literature

Scamman's Ferns and fern allies of New Hampshire.[1] This, the first separate account of New Hampshire Pteridophyta to be published and also the first complete and

[1] Scamman, Edith. Ferns and fern allies of New Hampshire. New Hampshire Academy of Science Bull. 2. 96, [2] p. incl. 18 pl. 1947.—Obtainable from Dr. R. L. Blickle, Secy.-Treas. N. H. Acad. Sci., Durham, N. H. ($1.25).

separately published treatment of the whole group for any New England state, was issued in the fall of 1947 but so far has had a relatively restricted circulation. It provides keys to families, genera, species, and varieties, and for each species brief synonymy, a paragraph or two discussing the distinctive characters, a statement of general range and another covering the New Hampshire distribution with citation of county or town records for species that are not found throughout the state. Most of the species are illustrated by line drawings, which will be of much assistance in identification; those of the ferns are by Dr. Shirley Gale Cross and Gordon W. Dillon, those of horsetails and lycopods (and one plate of *Dryopteris*) by Mrs. Una F. Weatherby. The work closes with a fairly ample bibliography, a glossary, a list of authors cited, and a full index. It contains, according to the author's count, 71 species and 60 additional varieties, forms, and hybrids. Twenty species have been seen from all 10 counties of the state, and 11 others from all but one or two counties; 7 species are known from only one or two stations each.

Miss Scamman's pamphlet provides a very satisfactory account of a group that has always been of special interest to New England botanists; the inclusion of an outline map showing the counties would have made it easier for the reader to visualize the ranges given. The work naturally invites comparison with the only similar treatise for any other New England state, Mrs. Edith B. Ogden's The Ferns of Maine.[2] The latter covers a more restricted field in greater detail. It includes the Filicineae only; it gives rather full descriptions of the species (as well as keys), with citation of localities for all specimens seen or recorded in the literature, and a similar although less lengthy treatment for each variety and form.—S. F. Blake.

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[2] Reviewed in this JOURNAL 39: 94. 1949.

American Fern Society

Report of the President for 1949

The Society continued its diversified activities through its annual meeting, held in New York City in conjunction with the American Association for the Advancement of Science convention, by means of 128 printed pages of its Journal, and through a flow of correspondence between its Council and interested persons everywhere. Sixteen authors, including some persons who recently joined the Society, contributed the principal articles to the Journal. It is the blood of the Society, as with similar groups of devotees of natural history, that the members share their new knowledge with other students for all time by means of verifiable publication.

The twenty-five year index to the Journal is now supplemented by an index of illustrations which together should provide a key to the information contained in the past volumes of the Society's Journal. Readers and contributors will profit by the use of these indices. Your editor, C. V. Morton, who prepared this last index to illustrations, suggests that photographers of the Society turn their talents to the southern and southwestern ferns which up to now have been seldom illustrated.

The loss by death of our honorary member, sometime devoted officer, and friend, Charles Alfred Weatherby, is truly irreparable. Distinguished as he was for his honest scholarship, his important botanical contributions, and his long years of service to the nation's foremost academic botanical center, Weatherby generously gave of his time and knowledge to all: veteran researcher and young student. His calm judgment, modestly proffered, carried the Society through many a crisis and controversy. Many of us recall his warm friendship and spirited repartee.

On behalf of the Society I should like to thank our retiring Secretary, Mrs. Elsie Gibson Whitney, for her long and valuable service to the organization. Your president has profited repeatedly from her assistance, and I'm sure the hundreds of persons who have sought information from her on matters pteridological, horticultural, and botanical generally, appreciate her kind assistance.

I believe the Society is fortunate in bringing to its Council the services of Miss Edith Scamman, whose field work in Alaska has made her name familiar to the membership.

Individual members' suggestions as to ways in which the Society may be of greater value are always welcomed by the Council. Members may be reminded of the possibility of organizing local study groups and field trips, using the membership lists to recruit persons likely to be interested. New techniques in photography offer a fresh approach to fern study. New portable field equipment for testing soils and soil acidity opens up horizons in the ecology of ferns for those members of a chemical turn of mind. Prothallia grown in small greenhouses or in one's own home may yield significant studies of their comparative morphology; some of these have been published in the Journal. Findings in this subject bear importantly on problems in fern phylogeny. Those members having private planes should include gelatine plates in their flight equipment for the collecting of fern spore data. It is from such data that we shall ultimately learn about the long distance dispersal of fern spores, the dynamics of air-borne microorganisms, and related matters.

Members are reminded that the Society plans to join the Botanical Society of America in September this year for its annual meeting in Columbus, Ohio.

Joseph Ewan, *President.*

Report of the Secretary for 1949

During the year 1949 there were added to the membership of your Society the names of seventy-five new members with geographical representation from Canada, Central America and Argentina as well as from New England to California and from Florida and Texas to Minnesota in the United States.

Through resignations and non-payment of dues we have lost thirty during the year, and death has levied a toll of six. This death toll has been an especially severe loss to the Society, including as it has some of our staunchest supporters of long standing. Evelyn James Winslow became a member in 1902 when the Society was the struggling young Linnaean Fern Chapter of the Agassiz Association, and he was the second member to take out a Life Membership. His continuous services to the Society were recounted in the Journal (Vol. 39: No. 3).

John Hendley Barnhart was one of a considerable number of new members who came to the support of the Society in 1910 and 1911 when it undertook the uncertain task of publishing its own Journal, and his support continued over these many years. A number of our members can testify to his willing help with biographic references and vital statistics.

For almost every year since becoming a member in 1912 Charles Alfred Weatherby served the Society in one official capacity or another and always with the greatest care for details to assure a clear-cut and progressive record for the Society. His many unofficial aids to the Society and to individual members will never be known.

Mrs. Carlotta C. Hall, a member since 1913, served as Vice-President from 1925 to 1937. She was a most devoted representative for the Society in the West Coast area who will be greatly missed.

Dr. Homer D. House, who as a college youth had "hunted ferns" with Dr. Maxon in central New York, became a member and served a brief term as Secretary at the turn of the century. Then pressure of other duties caused him to resign from the Linnaean Fern Chapter, to rejoin it as the American Fern Society in 1918, and continue as a member until his death last December.

William A. Knight, who like Dr. Maxon and Dr. House was originally from central New York, had been a member since 1931. He found an interest in ferns in North Carolina and in Florida where he spent his later years until his recent death.

All these members of so many years' association will be sorely missed. Counting up these gains and losses the total membership at the year's end stands at four hundred and thirty-three.

No general Field Meeting of the Society was held this year, but the Annual Program Meeting, held in connection with the meetings of the American Association for the Advancement of Science in New York City, was well attended. A full report of this meeting will be found elsewhere in the Journal.

It is with mingled feelings of relief and regret that the duties as Secretary are now passed on to another—regrets that many ways in which the interests of the Society's members might have been served have not been more fully developed, and relief and satisfaction that the office will be filled by so capable a person as you have selected in Miss Edith Scamman. There has been much delight and satisfaction in working with such loyal and unselfish groups as the officials of your Society have been, and to experience the cheerful co-operation of every member who has been asked for any sort of help.

Respectfully submitted,

ELSIE GIBSON WHITNEY, *Secretary.*

Report of the Treasurer for 1949

The Fern Society has come through the year with a comfortable cash balance. This has been largely due to an intensive campaign by our Editor to obtain new members and to sell back numbers of the Journal. The income from the former amounts to $104.50 and from sale of back Journals (including 9 complete sets) $493.95. Surplus Fern Society Library books and pamphlets brought in $116.65.

The Society is grateful also for the substantial gifts toward the added cost for the valuable Maxon Memorial number.

No withdrawals have been made from the two special accounts or the reserve fund. As a matter of convenience the Illustrations Fund has been merged with the cash account.

Our thanks are due to the many loyal members who have aided in obtaining new members or subscribers.

Receipts	*Amount*	*Sub-total*	*Total*
Cash on hand Jan. 1, 1949		$773.22	
Illustration fund		117.94	$ 891.16
1948 Membership arrears	$ 40.00	40.00	
1949 Membership renewals	568.00		
1949 New members	104.50	672.50	
1950 Membership renewals	51.00	51.00	
1951 Membership renewals	1.00	1.00	
1948 Subscription arrears	6.00	6.00	
1949 Subscription renewals	100.75		
1949 New subscribers	27.20	127.95	
1950 Subscription renewals	118.30	118.30	
Life memberships	none		
Sale of back numbers A.F.J.	493.95	493.95	
Sale of A.F.J. cumulative index	2.25	2.25	
Sale of Vars and Forms	1.00	1.00	
Sale of Fern Bulletin	.50	.50	
1949 Advertising	4.00	4.00	
Reprints	137.22	137.22	
Gifts for illustrations	5.31	5.31	
Gifts for Maxon Memorial No.	176.50	176.50	
Sale surplus Library books	116.65	116.65	$1,954.13
			$2,845.29
Deduction a/c Agency commission (subscribers)*			21.60
			$2,823.69

* Deducted at source of subscription.

Disbursements	*Amount*	*Sub-total*	*Total*
Business Press, Inc.			
A.F.J. Vol. 38, No. 4 (Maxon no.)	$800.81		
A.F.J. Vol. 39, No. 1	228.65		
A.F.J. Vol. 39, No. 2	190.11		
A.F.J. Vol. 39, No. 3	243.27	$1,462.84	
2500 printed envelopes	31.63	31.63	
Reprints	137.22	137.22	
Reprinting 50 each A.F.J. 2 nos.	124.50	124.50	
200 membership record cards	2.38	2.38	
Excess dues returned	1.40	1.40	
Recorder of Deeds, Wash., D. C. (certified Treas. statement)	.50	.50	
Expense			
President	1.83	1.83	
Treasurer	32.49	32.49	
Secretary	29.50	29.50	
Editor	17.19	17.19	$1,841.48
Cash on hand Jan. 1, 1950			$ 982.21

Statement, December 31, 1949

Assets

Cash on hand (incl. Illus. fund)	$ 982.21	
In Spec. Acct. #1	534.79	
In Spec. Acct. #2	352.73	
In Reserve fund	1,463.60	$3,333.33
Inventory A.F.J.	500.00	500.00
A.F.S. Library	300.00	300.00
		$4,133.33

Liabilities

Capital Acct.	$2,810.80
Suspense Cr.	
1950 membership	51.00
1951 membership	1.00
1950 subscription	118.30
1951 subscription	1.35
Distrib. vol. 39, no. 4	263.36
Bissell Herb. fund	534.79
Life Memb. fund	352.73
	$4,133.33

Respectfully submitted,

Walter S. Allen, *Treasurer*

Report of the Auditing Committee

We certify that the 1949 Financial Statement of the American Fern Society is true and correct. The Auditing Committee compliments Mr. Allen for his careful and efficient work.

WILLIAM DURKIN
F. L. FAGLEY
Auditing Committee

Report of the Judge of Elections
March 16, 1950

The results of the recent balloting for officers of the American Fern Society for the year 1950 are as follows:

For President			
Joseph Ewan	133		
Dr. Donovan S. Correll	1		
For Vice-President			
Dr. Donovan S. Correll	133		
Dr. Edgar T. Wherry	1		
For Secretary			
Miss Edith Scamman	134		
R. M. Tryon, Jr.	1		
For Treasurer			
W. S. Allen	135		
Elected to Honorary Membership			
Sr. Gualterio Looser	138	(yes)	1 (no)
Amendments to the Constitution			
Art. III, Sec. 4	132	(yes)	1 (no)
Art. III, Sec. 5	131	(yes)	3 (no)

I therefore declare the following candidates elected to the several offices: President, Dr. Joseph Ewan; Vice-President, Dr. Donovan S. Correll; Secretary, Miss Edith Scamman; Treasurer, Mr. W. S. Allen. Elected to Honorary Membership, Sr. Gualterio Looser. Amendments to the Constitution, Article III, Sections 4 and 5, carried.

Respectfully submitted,
DWIGHT M. MOORE, *Judge of Elections*

Report of the Curator and Librarian for 1949

At the request of the Council a complete inventory was made of the Library and an up-to-date catalogue was prepared. In addition a list was made of duplicates and non-pteridological titles. The latter material is being offered for sale and the list is circulating among the members who have requested it. The Society is indebted to Mrs. M. F. Somerville for the donation of books to add to the sale list and to Mrs. E. F. Myers for a gift of fern books from the library of her father the late E. J. Winslow. Especially important additions to the Library by this gift were Hooker's Species Filicum and Hooker & Baker's Synopsis Filicum.

Relatively few requests have been received for the loan of specimens from the Herbarium. With the thought in mind that it might be used to greater advantage if its contents were better known the following brief account is given.

There about six thousand mounted sheets in the Herbarium primarily of the ferns and fern allies of the United States. Nearly all of the species of our country are represented by at least one sheet and many of them have an ample series illustrating the normal variation. There are specimens of many of the named varieties and forms, and, especially in *Dryopteris* and *Asplenium*, a good series of the known hybrids. In all, something more than four hundred named kinds are represented. There is also a surprisingly good selection of foreign material including species in about one hundred genera. There is some material from nearly all parts of the world, but Mexico, Cuba, Jamaica, Europe, China, the Philippine Islands and the Hawaiian Islands are especially well represented.

Respectfully submitted,
R. M. TRYON, JR., *Curator and Librarian*

Report of the New York Meeting, 1949

The annual Program Meeting of the Society was held in connection with the week's Convocation of the American Association for the Advancement of Science which took place the last week of December in New York City. The choice of this great center, which is approximately the geographical center of about seventy per cent of our membership, assured an attendance larger than usual. Seventy-five members and friends of the Society gathered in the Blue Room, Hotel McAlpin, Friday afternoon, December 30th.

Our former president, Dr. Frederick L. Fagley, who had arranged the program, presided. His words of greeting to those present were followed by an announcement of the death last June of Mr. Charles Alfred Weatherby, who just a year previously had been elected to Honorary Membership. As a token of respect and honor the assemblage stood for a moment of silent tribute.

The program opened with a discussion by Dr. E. T. Wherry on "Distribution Patterns of Some Eastern Ferns." Either the more complete survey of the areas, or the natural spreading of some species, or both, is bringing to our knowledge previously unknown outlying stations for certain species. It was suggested that a committee be organized to collect and record all available data on marginal areas of distribution for the critical species.

Dr. Wherry also gave the report of Mr. J. E. Benedict, Jr., on "An Onoclea-like Lorinseria," with a mounted specimen of the plant.

In discussing the "Ferns of Long Island," Dr. H. K. Svenson emphasized especially some of the species unexpectedly found there which are perhaps at the margin of their ranges. He had several mounted specimens from a Long Island station for distribution to the members—one sheet of which was taken for the Society's Herbarium.

Last summer's exploration in the Rocky Mountains from the United States into Canada gave the data which our President, Joseph Ewan, presented in "Distribution Patterns among Ferns and Lycosphens of the Canadian Rockies." His interesting description of the geographical distribution of the many species, their over-lapping and abrupt endings, gave us new understanding of the natural barriers to distribution.

Our Librarian, Dr. R. M. Tryon, Jr., reported finding "An Unknown and Unpublished Fern Booklet" that is of historical interest, and also involves the nomenclature of some ferns.

The finding of a great variety of forms of some of our common eastern United States ferns within a short distance of New York City was described by Mr. Charles Neidorf, and illustrated with enlarged photographs of the various forms which gave almost a microscopic enlargement of the details.

From every standpoint this was a very successful meeting. The wide, and, in some areas, scattered distribution of Society members makes it impossible for all our program meetings to be so well attended. But perhaps for just that reason the reports of fern studies from those areas become increasingly important to add to our total knowledge of ferns.

We all look forward expectantly for the next general meeting of the Society. Watch for an announcement of its time and place.

ELSIE G. WHITNEY, *Secretary.*

How much is Eaton's Ferns of North America worth? That it is the one best work on American ferns goes without saying. A line on its possible present monetary value was afforded recently at a book auction (Swann's, New York City) when a dealer who specializes in botanical texts bid in a good set of Eaton for $32.50. One such auction purchase does not absolutely establish a standard of value. Books which may be fairly common in second-hand book stores sometimes sell at auctions at unexpectedly high prices. However, the Eaton book does not appear to be often available. Presumably the sale here reported gives a good base value.—R. C. BENEDICT.

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C. V. MORTON
R. C. BENEDICT IRA L. WIGGINS

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A regular loan department is maintained in connection with the library and herbarium. Members may borrow books and specimens at any time, the borrower paying all postal or express charges. The pages of the Journal also are open to members who wish to arrange exchanges; a membership list is published at intervals, to assist those interested in obtaining specimens from different localities.

American Fern Journal

VOL. 40 JULY–SEPTEMBER, 1950 No. 3

Two Varieties of Cystopteris fragilis

R. L. McGREGOR

During the season of 1947, while the author was collecting in eastern Kansas, a plant was found which was at first determined as *Cystopteris bulbifera* (L.) Bernh., because of the presence of bulblets on the frond. This identification was later recognized as incorrect, since in most other characters the plant strongly resembled *Cystopteris fragilis* (L.) Bernh. In the matter of leaf form and size and shape of the indusium, the specimens fall within the range of variability known for *C. fragilis.* The presence of the bulblets and minute white glands on the frond could not be ignored, however, so specimens were sent to Mr. C. A. Weatherby of the Gray Herbarium. He promptly replied that the specimens represented an undescribed variety of *Cystopteris fragilis,* but recommended more field study and the growing of the plants from spores and bulblets. This work was completed during the spring of 1949. Mr. Weatherby and the author had begun writing a joint paper on the new variety when the untimely death of Mr. Weatherby left the task in the author's hands.

After the present paper has been submitted for possible publication it was found that the fern which Mr. Weatherby and the author had considered to be a new variety of *Cystopteris fragilis* had been described as *Cystopteris tennesseensis* Shaver. Specimens of *C. tennesseensis* obtained on loan from the National Herbarium are identical with the fern in question. Prof. Shaver

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regards *C. tennesseensis* as a hybrid between *Cystopteris fragilis* (L.) Bernh. var. *protrusa* Weatherby and *Cystopteris bulbifera* (L.) Bernh. However, in a large part of the range of the supposed hybrid one does not find *C. bulbifera.* In Kansas *C. bulbifera* is unknown and in western Missouri it is rare. Yet in both of these areas a great abundance of the new fern is to be found. The present author regards the entity to be of hybrid origin, as will be mentioned later, but it now is a self-perpetuating plant which has become established over a considerable area. The intensive study of the fern in question by the present author has led to the conclusion that the plant is not deserving of more than varietal rank. This view was also held by Mr. Weatherby. It seems, therefore, that a new combination is in order.

CYSTOPTERIS FRAGILIS (L.) Bernh. var. **tennesseensis** (Shaver) McGregor, comb. nov.
Cystopteris tennesseensis Shaver, Journ. Tenn. Acad. Sci. **25**: 106–113. 1950.

The distinguishing characteristics of var. *tennesseensis* are the minute, white, unicellular glands on the lower surface of the pinnae and the bulblets borne on the under side of the rhachis and sometimes on the under side of the pinnae. The bulblets always bear a few pluricellular trichomes tipped by a brown gland and brown, membranous scales. The presence of the minute glands and the bulblets are, of course, characters usually associated with *C. bulbifera.* The possibility that our new variety might be a hybrid between *C. fragilis* and *C. bulbifera* was discussed by Mr. Weatherby and the author. Our decision was that our plant was originally of hybrid origin, but is now established as a genetic entity over a considerable area. It reproduces both by spores and bulblets. In many areas of its range it forms large colonies on suitable habitats. It is much more abundant in eastern Kansas and western Missouri than in the more eastern and southern part of its range.

RANGE: In crevices of limestone and sandstone rocks, rarely on soil, in Missouri, central Tennessee, northern Arkansas, northeastern Oklahoma, and the eastern half of Kansas.

REPRESENTATIVE COLLECTIONS:[1]

ARKANSAS: BENTON: Crevices of limestone rocks, Martins Bluff, Aug. 18, 1949, *McGregor* 3735; Martins Bluff, May 21, 1948, *D. M. Moore* 480219. IZARD: Near Calico Rock, July 13, 1942, *Demaree* 23513. SEARCY: Buffalo River, Highway 14, July 28, 1935, *D. M. Moore* 350144. WASHINGTON: in talus below cliff, north end of Kessler Mountain, May, 1931, *Orin Henbest* 17.

OKLAHOMA: CREEK: East of Country Club, Sapulpa, June 11, 1933, *Featherly & Still* 9. DELAWARE: On rocks, Dripping Springs, Aug. 19, 1949, *McGregor* 3749. OSAGE: On sandstone rocks near Pawhuska, Aug. 10, 1913, *Stevens* 2007.

KANSAS: ALLEN: On limestone rocks, 1 mile south of Humboldt, July 7, 1949, *McGregor* 3333. ANDERSON: On limestone rocks, 2 miles south of Garnett, July 20, 1949, *McGregor* 3457. BOURBON: On limestone rocks, 1 mile south of Uniontown, July 7, 1949, *McGregor* 3345. CHAUTAUQUA: On sandstone rocks, 1½ miles northeast of Sedan, July 8, 1949, *McGregor* 3384. CLAY: North of Wakefield, Sept. 29, 1895, *Inis Avery*. COWLEY: On limestone rocks, 3 miles southeast of Arkansas City, July 23, 1947, *W. H. Horr*. DOUGLAS: On sandstone rocks, 5 miles west of Baldwin City, June 18, 1949, *McGregor* 3102. ELLSWORTH: On sandstone rocks, 8 miles southeast of Kanapolis, June 26, 1949, *McGregor* 3302. FRANKLIN: On limestone rocks, ½ mile southeast of Ottawa, June 28, 1949, *McGregor* 3310. JEFFERSON: Limestone rocks, 5 miles south of Oskaloosa, July 19, 1949, *McGregor* 3452. JOHNSON: Crevices of limestone rocks, 2½ miles south of Stanley, Aug. 22, 1949, *McGregor* 3876. LEAVENWORTH: Common on sandstone rocks, 1 mile south of Kent, June 18, 1948, *McGregor* 1585. LINN: On limestone rocks, 3 miles northeast of Pleasanton, July 20, 1949, *McGregor* 3470. MIAMI: On limestone rocks, Miami County State Park, Oct. 19, 1947, *W. H. Horr*. MONTGOMERY:

[1] Arranged by counties. During the course of this study specimens were studied from the Gray Herbarium, Missouri Botanical Garden, Univ. of Arkansas, Oklahoma A. & M. College, Kansas State College, and the Univ. of Kansas. The author wishes to thank the curators of these herbaria for the loan of specimens.

On limestone rocks, 5 miles east and 2 miles south of Elk City, July 8, 1949, *McGregor* 3391. OSAGE: On sandstone rocks, 6 miles south of Quenomo, July 1, 1949, *McGregor* 3320. RICE: On sandstone rocks, 1 mile east of Genesco, April 30, 1949, *McGregor* 2704. SALINE: On sandstone rocks, 2 miles northwest of Brookville, April 30, 1949, *McGregor* 2688. SHAWNEE: Topeka, May, 1897, *B. B. Smyth.* WILSON: On limestone rocks, 2 miles west of Neodesha, July 9, 1949, *McGregor* 3404. WOODSON: On sandstone rocks, 2 miles west of Yates Center, June 19, 1949, *McGregor* 3192. WYANDOTTE: On limestone rocks, 2 miles southeast of Wolcott, Sept. 6, 1948, *McGregor* 2418; Oct. 3, 1889, *Minnie Reed.*

MISSOURI: CAPE GERARDEAU: Limestone bluffs, June 21, 1920, *E. J. Palmer* 18007. CASS: On limestone rocks, 1½ miles west of Belton, July 15, 1949, *McGregor* 3441. CLAY: Near Excelsior Springs, March 3, 1900, *J. T. Duncan.* DADE: Sandstone area, 3 miles east of Everton, June 23, 1941, *Steyermark* 40252. GREENE: May 5, 1888, coll. unknown. JACKSON: On limestone rocks, 5 miles northeast of Independence, July 26, 1949, *McGregor* 3515; near Raytown, May 24, 1895, *Mackenzie* 815. JASPER: Moist limestone ledges, 5 miles northeast of Webb City, June 5, 1910, *E. J. Palmer* 2964. JEFFERSON: July 28, 1898, *Trelease.* LINCOLN: Sept. 14, 1910, *John Davis.* MCDONALD: On rocks, Aug. 7, 1908, *Bush* 4985. NEWTON: On rocks, Aug. 7, 1908, *E. J. Palmer* 1447. OZARK: Shaded dolomite bluffs near Pontiac, June 27, 1928, *E. J. Palmer* 34780. PHELPS: On rocks, June 15, 1914, *J. H. Kellogg.* POLK: Sandstone bluffs, ½ mile north of Burns, July 17, 1934, *Steyermark* 13647. PULASKI: On rocks, Aug. 12, 1897, *Trelease.* PUTMAN: Shaded banks near Livonia, Sept. 21, 1915, *Bush* 7778. STONE: Sheltons ravine, May 20, 1916, *S. F. Prince* 277. ST. CHARLES: Oct. 21, 1897, *Trelease.* TANEY: On rocks near Branson, Oct. 27, 1908, *Bush* 5375.

CYSTOPTERIS FRAGILIS (L.) Bernh. var. **simulans** (Weatherby) McGregor, comb. nov.

Cystopteris fragilis forma *simulans* Weatherby, Rhodora **37**: 376. 1935.

While working on the above new variety of *Cystopteris fragilis,* Mr. Weatherby and the author were faced with the problem of the plant designated as *C. fragilis* forma *simulans* by Mr. Weatherby. The known range of this form had been extended and many specimens were available for study. As a result it was decided to raise forma *simulans* to the status of a variety. This raise in rank seems advisable since the characteristics that distinguish the plant, are found to be more constant than at first believed and its geographic range is more clearly defined.

Variety *simulans* seems to be closely related to variety *tennesseensis*. It is distinguished from all other varieties of the species by its broadly deltoid obtuse pinnae, which are often half as wide as long, obtuse secondary segments, the outer with nearly parallel sides, and uniformly large and conspicuous sori. In some cases it intergrades from this striking leaf form back to typical *C. fragilis*. In other cases it is known to produce small bulblets on the rachis, but minute white glands have not been found. Such plants closely resemble specimens of var. *tennesseensis*. The latter intergradation is the most common of the two types encountered. The ranges of var. *simulans* and var. *tennesseensis* overlap considerably. However var. *simulans* is predominant in eastern Missouri and northern Arkansas, whereas var. *tennesseensis* is most abundant in eastern Kansas, western Missouri and northeastern Oklahoma.

Since varieties *tennesseensis* and *simulans* do occupy nearly the same geographic area and since the bulblets characteristic of *Cystopteris bulbifera* are of common occurrence on var. *tennesseensis* and not unknown on variety *simulans*, it seems possible that in the general Ozark plateau region a self-perpetuating bulbiferous strain more or less intermediate in characters between *C. fragilis* and *C. bulbifera* has arisen. This has split into two subsidiary lines in the matter of leaf form, one var. *simulans*, the other variety *tennesseensis*. In the matter of leaf form var. *tennesseensis* closely resembles typical *C. fragilis*, but has retained the bulblets and glands of *C. bulbifera*, though these structures are somewhat modified. Variety *simulans* has a leaf form more like young specimens of *C. bulbifera,* but is without glands, and bulblets are very rare. In other characters, except those which distinguish it as a variety, it resembles typical *C. fragilis.* The two varieties as indicated above seem to indicate a tendency toward a geographic separation.

REPRESENTATIVE COLLECTIONS:

ILLINOIS: Limestone rock near Joliet, *J. H. Feriss;* Salt Creek, near Urbana, June, 1913, *S. F. Prince.*

ARKANSAS: BENTON: Shaded limestone cliffs, Sulphur Springs, Sept. 5, 1913, *E. J. Palmer* 4137. IZARD: Rocky ledges along river near Calico Rock, April 27, 1929, *E. J. Palmer* 35569. OPTIMUS: On rocks, July 12, 1942, *Demaree* 23457.

KANSAS: CHAUTAUQUA: On sandstone rocks, 1½ miles northeast of Sedan, July 8, 1946, *McGregor* 944. GREENWOOD: On sandstone rocks, 1 mile east of Fall River, April 9, 1949, *McGregor* 3412. MONTGOMERY: On limestone rocks, 8 miles west of Sycamore, Sept. 1, 1948, *McGregor* 2399. WILSON: On limestone rocks, 3 miles west of Neodesha, July 7, 1946, *McGregor* 925.

OKLAHOMA: CIMARRON: Side of sandstone butte near Kenton, May 15, 1913, *Stevens* 496. CREEK: East of Sapulpa Country Club, June 11, 1932, *Featherly* 10. LATIMER: Robbers Canyon, near Wilburton, July 9, 1931, *Featherly* 49. MURRAY: Limestone bluffs near Davis, Arbuckle Mountains, Oct. 10, 1933, *E. J. Palmer* 44068. OTTAWA: On moist face of overhanging bluff, near Dripping Springs, Aug. 27, 1913, *Stevens* 2410. PAYNE: Near Cushing, June 17, 1932, *Featherly* 9.

MISSOURI: BARRY: Roaring River, Sept. 7, 1898, *Trelease.* CAMDEN: Sept. 17, 1897, *Trelease.* CEDAR: Limestone bluffs along Sac River, northwest of Stockton, July 14, 1934, *Steyermark* 13475. CRAWFORD: July 10, 1926, *Woodson* 662. FRANKLIN: Gray Summit, June 16, 1927, *J. H. Kellogg* 807. GREENE: near Turners, 1912, *S. F. Prince* 268. HICKORY: Limestone bluffs along Niangua River east of Jordan, July 10, 1934, *Steyermark* 13292. JASPER: Moist limestone ledge, 4 miles south of Carthage, July 3, 1910, *E. J. Palmer* 2977. JEFFERSON: Rocks near Sulphur Springs, October 1852, *Engelmann.* LEWIS: Woods, La Grange, Sept. 14, 1911, *John Davis* (Type, Gray Herbarium). LINCOLN: Limestone bluffs near Whiteside, May 19, 1917, *John Davis.* MADISON: Moist shaded banks near Fredericktown, Sept. 7, 1926, *E. J. Palmer* 31621. McDONALD: Limestone cliff, 1 mile northeast of Noel, Aug. 13, 1949, *McGregor* 3657. MILLER: Bagnell, Sept. 18, 1897, *Trelease.* OZARK: Moist shaded dolomite ledges near Pontiac, Oct. 11, 1927, *E. J. Palmer* 33095. PIKE: Dry rocky ledges, Clarksville, June 18, 1911, *John Davis.* POLK: Limestone bluffs along Pomme de Terre River, ½ mile north of Burns, July 17, 1934, *Steyermark* 13574. PULASKI: Near Onyx Cave, Aug. 12, 1897, *Trelease.* RALLS: Bear Creek bluff, near Oakwood, Oct. 18, 1915, *John Davis.* ST. CHARLES: Limestone bluffs, Watson, Oct. 21, 1897, *Trelease.* ST. GENEVIEVE: Aug. 30, 1898, *Trelease.* STONE: Moist limestone rocks near Galena, Oct. 18, 1913, *E. J. Palmer* 4692. TANEY: Forsythe, Aug. 7, 1897, *Treleasè.* WASHINGTON: Near Irondale, 1867, *Edward Harrison.*

UNIVERSITY OF KANSAS, LAWRENCE, KANSAS

The Upright Psilotum

ALEX D. HAWKES AND OTTO DEGENER[1]

The members of the genus *Psilotum* (Psilotum Family), of which two types—the Upright Psilotum (*P. nudum*), the subject of the present note, and the Flat-Stemmed Psilotum (*P. complanatum*)—grow in the Hawaiian Islands, form a remarkable group of plants which are neither ferns, clubmosses nor flowering plants, but seem to resemble more closely certain primitive, long-extinct plants that are known only as fossils.

These Psilotums grow either on the ground or as epiphytes on trees, often forming rather large, grass-like clumps. The leaves are small and scale-like; in the upper part of the plant they are deeply divided and bear three-chambered yellowish sporangia, which when mature, split open to shed a cloud of dust-like spores. These spores germinate under favorable conditions into minute gametophytes, or prothalli, which grow entirely hidden under ground, in the crevices of rocks, or in the

[1] The material used herein, as well as the accompanying line plate, is largely taken from the writers' forthcoming book, PLANTS OF THE TROPICS.

PSILOTUM NUDUM

Psilotum nudum

decaying trunks of trees. At maturity the gametophyte produces microscopic antheridia and archegonia. Within the former numerous motile sperms develop, while within each archegonium rests a single egg. The sperms are finally liberated in wet weather and then actually swim to the archegonia to unite with the eggs. From this union arises the next sporophytic generation, the plants here illustrated.

The Upright Psilotum furnished the Hawaiians with two medicines. A tea, derived from boiling the plant, was given to babies suffering from the common disease called *ea* in Hawaiian and thrush in English; it was also drunk as a laxative or cathartic. The oily spores, on the other hand, were given to infants as a remedy for diarrhoea, and were also used like talcum powder to prevent chafing which occasionally occurred from wearing the *malo* or loin cloth.

The Upright Psilotum was also used in playing the Hawaiian game of "fighting cocks." Two players each took a branch of the plant and removed all but a single side twig. Then, holding the branch by the tip, the inverted twig acted as a hook. The two contestants locked hooks and slowly pulled until one or the other branch should break. The owner of the branch that remained intact thereupon declared his victory by crowing like a rooster.

In southern Florida and throughout the West Indies, the Upright Psilotum is very commonly found growing as a semi-epiphyte on or around the bases of the roots of the wild strangler-figs (*Ficus aurea, F. brevifolia, et al.*). It is occasionally collected and transplanted to collections of rare plants. It thrives under cultivation if treated like an epiphytic orchid, and soon forms a large and peculiar-appearing specimen which may grace any greenhouse or lathhouse.

COCONUT GROVE, FLORIDA.

Azolla caroliniana in Kentucky

THOMAS N. MCCOY

On June 14, 1948, I discovered a small colony of *Azolla caroliniana* Willd. in Kentucky. For several years it has been known to be very plentiful at Reelfoot Lake, Tennessee, but so far as the writer is aware this is the first record for Kentucky. The plants were collected in the sloughs and ponds in Fulton County which borders this area. The station was near "Floating Bridge" on Running Slough, Fulton County, Kentucky. I suppose there were about 1000 plants in this group. Specimens were sent to Dr. Henry K. Svenson, who identified them as *Azolla caroliniana* Willd. None of this material was fruiting and his determination was based on vegetative characteristics. Specimens have been deposited in the following herbaria: Gray Herbarium, Missouri Botanical Garden, and U. S. National Museum. Specimen were sent to the University of Kentucky Herbarium, but, along with all others, they were destroyed in the recent fire.

In Dr. Svenson's revision of the genus (1944), we are warned, "Nothing is known of the boundary between *A. caroliniana* and *A. mexicana*, which probably lies in the Texas-Louisiana region. Finally, the reader must not be too optimistic about the identification of sterile material." Reference to the convenient list of State and Local Fern Floras of the United States (Blake 1941), yielded the following information. The known stations based on authentic specimens deposited in different herbaria were in Florida, and up the Coast toward New York; then after a gap of a hundred miles from the mouth of the Mississippi River up the river to Iowa.

In an effort to see why Mississippi, Alabama, and Georgia were not represented in this distribution a letter was sent to each of the state universities with a request for a list of specimens of *A. caroliniana* in the different herbaria. Then the idea was expanded to include sixteen different institutions including four of the large herbaria. Replies were received from ten or twelve correspondents but only one of the herbaria had been arranged according to Svenson's detailed evaluation of the species.

Broun's Index to North American Ferns lists only two species. Svenson (1944) recognized four North American species. The material in the Brooklyn Botanic Garden Herbarium has not been arranged according to this paper. The label data there shows *A. caroliniana* Willd., from Lake Ontario to Florida and west to New Mexico. The specimens in the Missouri Botanical Garden have not (Dec. 14, 1948) been identified in accordance with Svenson's treatment, and so they considered a list of localities worthless. The Gray Herbarium is arranged according to Svenson so far that was possible. The Philadelphia Academy of Natural Sciences Herbarium is not arranged according to Svenson, and specimens are listed as *A. caroliniana* Willd., from Massachusetts to Florida and west to Texas and Nebraska.

Again let me call attention to Svenson's paper in that at least the fruiting specimens from central United States he refers to *A. mexicana* Presl. I should suppose that a Kentucky plant would be more likely to belong to this species. I am grateful to him for the determination of my material as *A. caroliniana* Willd., and since our geographic position is on the border line, I shall go ahead and try to find both species.

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ELKTON, KENTUCKY.

Notes on the Ferns of the Eastern United States

C. V. MORTON

In September, 1946, Dr. H. A. Gleason, of the New York Botanical Garden, invited me to prepare the treatment of the ferns and fern allies for his new Illustrated Flora. Dr. William R. Maxon had worked up the ferns for the second edition of Britton and Brown's Illustrated Flora. Dr. Maxon had been invited to prepare a revision, but he did not feel up to it. I accepted and forwarded the completed manuscript in December, 1948 (some corrections and additions were forwarded in January, 1950).

The work, although it covers the same ground as Dr. Maxon's treatment, is essentially my own, for all the descriptions and keys were redrawn. Dr. Maxon would perhaps not always agree with my treatment. Now that Dr. Gleason's work is about ready to be published it seems desirable that I should give in advance some explanation of my treatment of certain groups, especially since a few new combinations are needed.

I am reviewing elsewhere Professor M. L. Fernald's new Gray's Manual of Botany, which covers essentially the same range as Dr. Gleason's Flora. Those who are hoping for a complete agreement in the taxonomy and nomenclature of the species are going to be disappointed. It is perhaps inevitable that independent workers will not come to the same decisions, even on a group as well known as the ferns of the eastern United States. Naturally in some genera there is complete agreement between Dr. Fernald's treatment and my own; in most of the larger genera there is more or less disagreement. Dr. Fernald recognizes 130 species of native ferns and I 116.[1] Dr. Fernald also recognizes a great many more forms and

[1] Gray's Manual (7th edition) had 114, Dr. Maxon's treatment 128.

varieties than I have mentioned (in accordance with Dr. Gleason's instructions to be "temperate" in the recognition of subspecific categories). Dr. Fernald's detailed treatment of minor forms is certain to be of great usefulness.

GYMNOCARPIUM

For a long time now botanists have maintained the genus *Dryopteris* essentially as defined in Christensen's Index Filicum, although realizing that this vast genus might not be wholly homogeneous. Christensen himself suggested that it should be divided along natural lines. This has been done by Ching, Copeland, and others. The necessity for such a treatment will not appear obvious to some students. We have been accustomed to thinking that these plants all belong together. However, it seems likely that when we see a specimen, perhaps of a species unknown to us, and say "That is a *Dryopteris*," we are recognizing not a fundamental generic character of a genus *Dryopteris*, but a similarity to a certain species that is commonly referred to *Dryopteris*. If such species as *D. Thelypteris* and *D. noveboracensis* had always been referred to a distinct genus (e.g., *Thelypteris*) we should not perceive a very close similarity to true species of *Dryopteris*, such as *D. marginalis* or *D. Filix-mas*. In fact we should probably consider a suggestion to unite them into a single genus as preposterous. For *Thelypteris* not only has a different aspect but has distinct morphological and anatomical characters.

I have hesitated a long time before making this seemingly radical change in classification. I obtained my views on fern classification largely through my association for many years with Dr. William R. Maxon, who was notably conservative. Dr. Maxon always opposed the segregation of *Dryopteris*. So did that other conservative student, Mr. Weatherby, for many years, but he did eventually change his mind. In response to my request for his opinion as to what treatment I should use in the new Illustrated Flora, he replied (Nov. 21, 1947): "As to your immediate problems, so far as the flora of northeastern America is concerned I should be willing to accept *Thelypteris* and *Dryopteris* as separate genera, with *Gymnocarpium* as a very real difficulty, but probably to be placed with the former on habital grounds. There isn't any *Dryopteris* I can think of which has a running rootstock and solitary fronds. . . . I realize that I am far from definite; I haven't been able to make up my own mind yet."

Mr. Weatherby's opinions coincided with my own, except as to the disposition of *Gymnocarpium*. The generic name *Gymnocarpium* will be unfamiliar to many readers. The genus was described by Newman in 1851 and included three species, *G. Dryopteris, G. Robertianam,* and *G. Phegopteris.* As treated by Newman it was essentially the same as the genus *Phegopteris* (Presl) Fée, which must be typified by the beech-fern (*Polypodium Phegopteris* L.). Now, up to the present time certain writers, mostly those concerned with local floras, have maintained the genus *Phegopteris* to include both the beech-fern and the oak-fern (*Polypodium Dryopteris* L.). These two plants have in common an elongate, creeping rhizome and exindusiate sori. These two characters are obvious, but not fundamental ones in this group of plants. The beech-fern is closely allied in structure with typical *Thelypteris* (the marsh-fern). The oak-fern, on the contrary, differs widely. Ching realized this and published a paper entitled "On the Nomenclature and Systematic Position of Polypodium Dryopteris L. and Related Species."[2] He proposed that the oak-fern be regarded as a distinct genus, and revived the name *Gymnocarpium* for it, typifying the genus on *Polypodium*

[2] Contr. Biol. Lab. Sci. Soc. China **9**: 30–43. 1933.

Dryopteris. He may be followed in this typification.

The oak-fern is intermediate in many ways between *Thelypteris* and *Dryopteris.* I found that I could hardly define either genus satisfactorily if it was included, but it seemed to be nearer to *Dryopteris,* contrary to Mr. Weatherby's suggestion. This observation agreed with Holttum's comments in his exceedingly valuable paper "A Revised Classification of Leptosporangiate Ferns."[3] Holttum places *Thelypteris* in a separate family (Thelypteridaceae) from *Dryopteris* which is placed in the Dennstaedtiaceae, tribe Dryopteridoideae. In commenting on *Gymnocarpium,* Holttum wrote: "*Gymnocarpium* has the rachis-pinnule characters of *Dryopteris* and its immediate allies, and scales like *Dryopteris,* for which reasons a relationship to *Dryopteris* is indicated, though *Gymnocarpium* has a simpler anatomy than *Dryopteris* and a creeping apparently dorsiventral rhizome. In any event, it is not near *Thelypteris* and needs further investigation."[4]

Mr. Weatherby finally agreed and wrote me (March 9, 1948) "Have you noticed that Holttum agrees with you in putting the oak-fern with *Dryopteris?* It has some traces of a new character which he uses for *Dryopteris*—grooved upper surface of the costae, as opposed to convex ones in *Thelypteris.* I somehow can't imagine that this is a very important character, but in the few species I have looked at it seems to hold. I am inclined to think that, if I had to write a fern-flora of this region, I'd

[3] Journ. Linn. Soc. Bot. **35:** 123–158. 1946.

[4] In regard to putting *Thelypteris* and *Dryopteris* into different families Mr. Weatherby had this to say: "I cannot stomach these two as separate families, or even subfamilies. I do think you would be justified in keeping . . . Polypodiaceae until you have satisfied yourself as to how far and into what the other course is going to lead you. . . . I am still waiting for some phylogenist even to attempt to explain how so many lines of descent, from such different ancestors, managed to produce an almost perfectly uniform sporangial structure."

follow Ching (somewhat) and make a separate genus for the oak-fern. It seems to me to make difficult the definition of either *Dryopteris* or *Thelypteris,* if included."

I distinguish these three genera as follows:

Acicular, unicellular hairs present on costae above; segments ciliate; stipe bundles two, these united below base of blade; rhizome scales ciliate (sometimes sparingly); rhizomes slender, creeping; fronds membranaceous; veins reaching the margin. THELYPTERIS

Acicular hairs absent on costae above; segments not ciliate; stipe bundles free; rhizome scales not ciliate, sometimes toothed.

Lowest pinnae articulate to rhachis; stipe bundles two; veins reaching the margin; rhizomes slender, wide-creeping; blades membranaceous, deltoid; indusium none GYMNOCARPIUM

Lowest pinnae not articulate; stipe bundles 3–7; veins ending short of the margin in elongate hydathodes; rhizomes thick, short-creeping to erect; blades herbaceous to coriaceous, ovate to lanceolate; indusium present .... DRYOPTERIS

It should be emphasized that this key accounts only for the species of the northeastern United States. The inclusion of certain tropical groups would modify the key to some extent. I believe that *Cyclosorus* and *Goniopteris* should be included in *Thelypteris.* In the tropics there is also a third major genus, *Ctenitis,* to consider.

As to the name *Thelypteris,* it should be noted that Dr. Copeland[5] has revived the name *Lastrea* for this genus. He rejects *Thelypteris* on the ground that Schmidel did not use the binomial system of nomenclature and that he did not form a binomial. According to the Rules a genus may be validly described even though no species is named. The requirement that an author must be using the binomial system applies only to questions involving the validity of species names. It does not apply to generic names. Copeland states—"Of still more recent authors who adopt the name [*Thelypteris*], Alston, Kew

[5] Genera Filicum 135. 1947. Copeland includes *Gymnocarpium* in *Lastrea.*

Bull. (1932) 309, alone seems to have presented justification.'' Dr. Copeland evidently overlooked the paper by M. L. Fernald and C. A. Weatherby entitled: Schmidel's Publication of Thelypteris.''[6] Fernald and Weatherby show conclusively that Schmidel's publication is valid. Professor Fernald does not use *Thelypteris* in his new account in Gray's Manual, because he continues to maintain the marsh-fern in *Dryopteris*, and *Dryopteris* is a conserved name. However, the conservation of *Dryopteris* over *Thelypteris* does not prevent the use of the latter when the two genera are held to be distinct.

Our two species of *Gymnocarpium* are not always easily distinguished. The character assigned by Milde and adopted by Hultén and others, namely ''First pinnule on lower side of basal pinnae about equal in length to the third primary pinnae'' [*G. Dryopteris*] as opposed to ''first pinnule on lower side of basal pinnae about equal in length to fourth primary pinnae'' [*G. Robertianum*] does not hold very well. The difference in the division of the blade is usually rather easy to observe but hard to express quantitatively. I find that the following holds fairly well:

First pinnule on lower side of basal pinnae about equal to one third of the total length of the frond [i.e. the length of the primary rhachis] or longer .... *G. Dryopteris*
First pinnule on lower side of basal pinnae about one fourth as long as the frond or shorter .... *G. Robertianum*

DRYOPTERIS

In my treatment of *Dryopteris* (i.e. *Eudryopteris*) I have recognized seven species: *D. fragrans, D. Filix-mas, D. marginalis, D. cristata, D. Goldiana, D. Clintoniana,* and *D. austriaca* (*D. spinulosa*). Small and some other botanists have recognized a number of others (e.g. *D. celsa, D. Boottii, D. atropalustris, D. separabilis*) which sem to be hybrids. Natural hybrids between these spe-

[6] Rhodora **31: 21–26. 1929.**

cies were noted by Dowell[7] and Benedict.[8] The first two, *D. fragrans* and *D. Filix-mas,* mostly do not grow with the other species, so hybrids are consequently few; but the other species have apparently combined in almost all possible ways. Hybridity in these plants has been postulated chiefly on the basis of the possession of characters intermediate between the presumed parents, abnormalities, and putative sterility. A worthwhile discussion along modern lines is not possible at the present time. Such a study would require extensive genetic and cytological work.

At the same time it is scarcely to be doubted that natural hybrids do occur. Clinton's fern, *D. Clintoniana,* is recognized today either as a distinct species or as a variety of *D. cristata.* As Small points out, it is quite as much like *D. Goldiana* as *D. cristata,* a fact observable in the frequently abruptly acuminate blades, these only slightly reduced toward the base, the relatively large size of the plants, the larger, darker scales, and inframedial sori. It is more like *D. cristata* in the shape of the pinnae. It seems likely therefore that *D. Clintoniana* originated as a cross between *D. cristata* and *D. Goldiana,* and it therefore should not be regarded as a variety of *D. cristata.* It is perfectly fertile and reasonably constant; it is apparently an allopolyploid which can rank as a species. However, if this is true, it is evident that if *D. Clintoniana* is able to cross with other species, as seems likely, the resulting hybrids with *D. marginalis, D. austriaca,* and the back-crosses with *D. cristata* and *D. Goldiana* will defy analysis by ordinary herbarium techniques.

The most that can be done is to make guesses. From the abundant series of specimens collected in the Dismal Swamp area of Virginia by William Palmer and others

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7 Bull. Torr. Club **35**: 135–140. 1908.
8 Bull. Torr. Club **36**: 41–49. 1909.

I would guess that the controversial plant described as *D. Goldiana* subsp. *celsa* W. Palmer (*D. celsa* Small) is *D. Clintoniana* × *Goldiana,* as suggested by Wherry (Guide to Eastern Ferns). Dr. Fernald (in the new Gray's Manual) has recognized it as a valid species.

Another critical plant, also described from the Dismal Swamp, is *D. atropalustris* Small. Dr. Wherry identifies this as *D. cristata* × *Goldiana,* i.e. the same cross that resulted in *D. Clintoniana,* but it does not look like *Clintoniana.* The type specimen in the New York Botanical Garden does not show characters of *cristata,* but seems to me to have an evident strain of *D. marginalis.* I take it to be *D. Goldiana* × *marginalis.*

Another dubious plant is *D. Clintoniana* var. *australis* Wherry (*D. australis* Small), originally described from Alabama, but now reported from North Carolina, Louisiana, and Arkansas. Here again I see a strain of *D. marginalis* present, and there is a suggestion also of *D. ludoviciana* and *D. Clintoniana.* The plant may be, as Wherry diffidently suggested, a mixture of several species. Some other hybrids have received specific names (among them *D. Slossonae, D. pittsfordensis, D. separabilis, D. Boottii*).

From the above it might seem that the eastern United States population of wood-ferns is a "hybrid swarm," but such is scarcely the case. The great majority of plants in any locality are obviously referable to one or other of the basic species. The hybrids in most cases are rare or local.

DRYOPTERIS AUSTRIACA (Jacq.) Woynar ex Schinz & Thell. Vierteljahrssch. Naturf. Ges. Zürich **60**: 339. 1915.

In Christensen's Index Filicum, *Polypodium austriacum* Jacq.[9] is referred with a query to *Dryopteris spinulosa.* Later Woynar transferred the species to *Dryop-*

[9] Obs. Bot. 1: 45. 1764.

teris. Since *austriacum* has priority over *Polypodium spinulosum* Müll. it must be adopted for our spinulose shield-ferns if it really applies to this group. The original description is as follows (translated):

Polypodium austriacum. Fronds decompound, pilose; leaflets [i.e. pinnules] opposite or alternate; pinnae [segments] pinnatifid, lanceolate, the lower opposite and distant, the upper alternate and confluent into a leaflet; stipe lanuginose at base.

Habitat in subalpine woods of the Etsch. Fruits in October. Frond about 2 feet long, composed of about 8 opposite leaves [pinnae] and 3 terminal, the lowest [pinnae] about 8 inches long, the others decreasing in size. These themselves [i.e. pinnae] are bipinnate and composed of numerous alternate leaflets [i.e. pinnules], the lower often opposite, the longer about 3 inches long, the others decreasing in size. On these [pinnules] are placed pinnae [segments] at intervals of 3 or 4 lines, these obtuse, the larger 10 lines long, pinnatifid, the angles and sinuses obtuse, the lower opposite, the upper alternate and confluent. The petioles are all pilose, the pinnae and stipe less so; but this [stipe] at the base is enveloped in a silky wool.

It must be remembered that in 1764 fern terminology had not been standardized. A check with all the ferns growing in the Alps shows that *Dryopteris dilatata* is the only fern that corresponds at all with this description, and that it does agree in most respects. The description of the fronds as "pilose" is confusing, but I judge that Jacquin was refering to the scales; this is more or less shown by his statement that the base of the stipe is enveloped in a "silky wool"; this "wool" could only be the conspicuous basal scales of *Dryopteris dilatata.* It has been tentatively suggested that possibly Jacquin had a flowering plant rather than a fern in hand, but I do not believe that this is credible. Jacquin was a distinguished and accomplished botanist. He was unquestionably familiar with the genus *Polypodium* in the Linnaean sense.[10] If his material had been sterile one might have some vague doubts, but he says "fruits in October" and he surely knew the difference between the fruit [dots] of *Polypodium* and the fruit of any flowering plant.

The name *Dryopteris austriaca* has been adopted by several European botanists and by Hultén in his "Flora of Alaska." It is unfortunate that the well-known name *D. spinulosa* should be displaced, but there does not seem to be any alternative.

The varieties will be known as follows:

DRYOPTERIS AUSTRIACA var. DILATATA (Hoffm.) Fiori, Flora Italica Cryptogama **5**: 117. 1943.[11]

DRYOPTERIS AUSTRIACA var. SPINULOSA (Müll.) Fiori, Flora Italica Cryptogama **5**: 115. 1943.[12]

DRYOPTERIS AUSTRIACA var. **intermedia** (Muhl.) Morton, comb. nov. *Polypodium intermedium* Muhl. ex Willd. Sp. Plant. **5**: 262. 1810.

DRYOPTERIS AUSTRIACA var. **fructuosa** (Gilbert) Morton, comb. nov. *Nephrodium spinulosum fructuosum* Gilbert, List No. Amer. Pterid. 37. 1901.

DRYOPTERIS AUSTRIACA var. **concordiana** (Davenp.) Morton, comb. nov. *Nephrodium spinulosum* var. *concordianum* Davenp. Rhodora **6**: 33. 1904.

WOODSIA

WOODSIA OREGANA D. C. Eaton var. **Cathcartiana** (B. L. Rob.) Morton, comb. nov.

Woodsia Cathcartiana B. L. Rob. Rhodora **10**: 30. 1908.

Since the time of its original discovery by Miss Ellen Cathcart at Taylor's Falls of the St. Croix River, Minne-

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[10] It will be recalled that Linnaeus placed such plants as *Dryopteris marginalis* in *Polypodium*.

[11] Fiori attributed this combination to Underwood (1893), obviously an error. It may be that Fiori's varietal combination is not the earliest, but I have been unable to find another. Schinz and Thellung made the combination *D. austriaca* subsp. *dilatata*.

[12] Attributed to Kuntze (1891) in error. Schinz and Thellung made the combination *D. austriaca* subsp. *spinulosa*.

sota, in 1874, *Woodsia Cathcartiana* has puzzled fern students. D. C. Eaton originally referred the specimen to his *W. scopulina* (in Gray's Manual, ed. 6, 691. 1890), but B. L. Robinson realized that it was different and described it as new.

Recently Dr. T. M. C. Taylor[13] has considered it a variety of *W. pusilla* Fourn. (1880).[14] *Woodsia Cathcartiana* does resemble *W. mexicana* [*pusilla*] in many ways, but it is even closer to *W. oregana* D. C. Eaton, as noted by R. M. Tryon, Jr.;[15] in fact, these two are separable only with difficulty and by characters of probably secondary importance. The rhachis and costae of *W. oregana* are very sparingly glandular and the leaf surface entirely eglandular, whereas these are conspicuously glandular in *W. Cathcartiana*. The indusial segments in *W. Cathcartiana* are rather long (but by no means so long as in *W. mexicana*), and often overtop the sporangia. Those of *W. oregana* are shorter and mostly concealed; they are variable, sometimes principally of beadlike cells,[16] but more often broader and hairlike only at the tip.

Dr. Taylor[17] indicates that true *W. oregana* is eglandular in all stages and describes a f. *glandulosa*, based on material from Ontario, for those plants exhibiting glands. However, all specimens that I have examined, including those from Oregon, show some capitate-glands, although these may be very few and most noticeable at

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[13] Amer. Fern Journ. **37**: 86. 1947.

[14] Taylor uses the name *pusilla* in place of *Woodsia mexicana* Fee (1875), on the ground that the latter is a later homonym of *W. mexicana* R. Br. (in Wall. Pl. As. Rar. **1**: 41. 1830), but the latter is a *nomen nudum* and cannot be considered in matters of priority.

[15] Amer. Fern Journ. **38**: 168. 1948 [1949].

[16] As illustrated by Maxon, in Abrams' Illustrated Flora of the Pacific States.

[17] *Op. cit.* 85.

the bases of the pinnae. It seems, therefore, that f. *glandulosa* may be disregarded.

It seems, therefore, that *Woodsia Cathcartiana* is best considered as only a somewhat geographically isolated variety of *W. oregana,* although it must be admitted that the interrelationships in the section *Perrinia* are far from satisfactorily settled.

WOODSIA SCOPULINA D. C. Eaton var. **appalachiana** (T. M. C. Taylor) Morton, comb. nov.

Woodsia appalachiana T. M. C. Taylor, Amer. Fern Journ. **37**: 88. 1947.

The fern from the Allegheny Mountains which has commonly been referred to *W. scopulina* has been characterized as a new species by Professor T. M. C. Taylor. Although fern students have realized that it differs from typical western specimens of *W. scopulina,* the differences have not seemed conspicuous or fundamental. The rhizome scales are somewhat narrower and the indusial segments broader, but the plants agree with *W. scopulina* in so many features, in particular, in dissection and in the presence of long, articulate hairs on the costae and costules of the pinnae, that they seem better treated as a geographically isolated variety. The variety is rare and found only in a limited area in the Allegheny Mountains in Virginia, West Virginia, North Carolina, and Tennessee; there is an outlying station in the Ozark Mountains in Arkansas.

WOODSIA OBTUSA (Spreng.) Torr. In Broun's Index to North American Ferns, *W. obtusa* is said to range from Alaska to British Columbia. So far as I know this statement has no basis in fact, but strangely enough it appears again and again, e.g. in Maxon in Britton and Brown, Illustrated Flora, in Small's Ferns of the Southeastern States, in Wherry's Guide to Eastern Ferns, in Tryon *et al.* Ferns of Wisconsin, in Brown and Correll, Ferns and Fern Allies of Louisiana, in Ogden's Ferns of Maine, and elsewhere. All these records apparently go back to a misidentification by William Trelease as *W. obtusa* of an Alaskan specimen of *Cystopteris fragilis.* The Arizona record of Broun is based on a misidentification of *W. Plummerae.* The range is correctly stated by Professor Fernald in the new Gray's Manual.

ATHYRIUM

ATHYRIUM THELYPTEROIDES (Michx.) Desv. The silvery-spleenwort is widely distributed in the eastern United States, although not exactly common. There are two forms, in their extreme development almost suggesting two species—the typical form, which is the commonest and most widespread, has the segments of the pinnae with nearly straight, scarcely toothed sides and a rounded or subtruncate apex; the veins are mostly simple and the indusia rarely athyrioid; the other form, known as f. *acrostichoides* (Swartz) Gilbert, is more northerly in range, being known chiefly from Quebec to northern New England, west to Ontario and Wisconsin; it has broader, strongly toothed segments, with curved sides, and an obtuse or acutish tip; the veins are often forked in the sterile blades and the indusia are more often athyrioid. These two forms have been noted occasionally,[18] but apparently no serious field study has been made. Authors have assumed by their recognition of *acrostichoides* as merely a form, that these variations have little genetic significance but are ecological adaptations, but this remains to be demonstrated. It is particularly desirable to collect young stages as well as mature plants. These ferns should prove a suitable subject for "mass collecting" and statistical analysis.

To be continued.

[18] Cf. Gilbert, Fern Bull. **8**: 9. 1900; Winslow, Amer. Fern Journ. **1**: 79–82. 1911; Weatherby, Amer. Fern Journ. **26**: 131–132. 1936; Gruber, Amer. Fern Journ. **27**: 27. 1937.

Ctenitis vellea, a Neglected West Indian Fern

GEORGE R. PROCTOR

In his "A monograph of the genus Dryopteris,"[1] Christensen discusses briefly a rare West Indian fern first named *Aspidium velleum* by Willdenow in 1810. He states that the species "was founded on PLUMIER tab. 9, which plate illustrates a plant from San Domingo," and goes on to say that Hooker's *Nephrodium aureovestitum*, described in 1862 from Cuban material (*Linden* no. 1901) probably represents the same entity. However, he says that the only specimen he had seen was a single sheet collected by Jenman in Jamaica, now deposited at the U. S. National Herbarium.

G. S. Jenman, a nineteenth-century specialist on Jamaican ferns, who published (in serial form) the first (and, to date ,the last) comprehensive work on these plants,[2] states that the species is "common" in the region of the Manchester Mountains, at 2000 ft. elevation. However, the only specimen in the herbarium of the Jamaican Department of Agriculture (with which Jenman was connected, 1873–1879) is labeled as being from a cultivated plant at Castleton Gardens. Apparently William R. Maxon, who contributed so much to our knowledge of Jamaican ferns, never collected this species, though he visited localities where it occurs. However, he was acquainted with it from a number of old collections at the British Museum. My own attention was brought to this plant during the early part of March of this year, when, during the course of botanical collecting in the remote interior of the so-called "cockpit country" of southern Trelawny Parish, I was interested to find the species in question quite common there, growing in scattered colonies on shaded rocky hillsides, and a good series of specimens was obtained.

[1] Vid. Selsk. Skr. VII. 10[2]: 101. 1913.
[2] Bull. Bot. Dept. Jamaica, 1890–1898.

Dryopteris vellea (Willd.) Kuntze (1891) (as it has been called) belongs to the distinct group of fern species separated as the genus *Ctenitis* by Christensen in 1938.[3] When Copeland dealt with *Ctenitis* in his "Genera Filicum" (1947, pp. 123–125), he listed a large number of species, making new nomenclatural combinations wherever necessary. However, *D. vellea* was omitted from this treatment. It therefore seems desirable to make the transfer at this time; the plant may be known as ***Ctenitis* vellea** (Willd.) Proctor, comb. nov.

To bring the known distribution up date, the following records may be cited. The symbol "BM" refers to British Museum (Natural History), "K" to the Royal Botanic Gardens, Kew, "US" to the United States National Herbarium, "H" to the herbarium of the Botanical Department of Jamaica, situated at Hope Gardens, and "J" to the herbarium of the Institute of Jamaica, Kingston. I am indebted for the use of Dr. Maxon's notes for citation of the material at the British Museum and Kew, and to Mr. C. V. Morton for helpful suggestions.

CUBA: Province of Oriente: "Mt. Leban [Lebanon], St. Yago [Santiago] de Cuba, 1844. *Linden* n. 1901" (K). This is the type of Hooker's *Nephrodium aureo-vestitum;* however, as Hooker himself pointed out, only part of Linden's 1901 is this entity. The rest is *Dryopteris velata* (Kunze) Kuntze.

JAMAICA: Parish of Trelawny: Alps district, *R. V. Sherring* (BM, K, US); Windsor Cave, *Proctor* 4720 (J); 5 miles north of Quick Step, *Proctor* 4064(J, US). Parish of St. Elizabeth: 1 mile south of Ipswich, *Proctor* 4619 (J). Parish of Manchester: "Interior", *Wm. Purdie* in 1844 (BM, K); "Manchester Hills", *Jenman* 34 (K). Without locality: *Wilson* 67, in 1845 (BM, K, photo US); also "Cult. Hort. Castleton" *Jenman,* "J. P. 2051" (H).

HAITI: "Grand Riviere, au quartier de Leogane," *Plumier* (type, probably not extant, represented by t. 49 of "Traitté des Fougères

[3] Verdoorn's Manual, p. 544.

de l'Amérique'', 1705). There is some question as to whether the plant somewhat crudely figured by Plumier is actually the same as the species of Cuba and Jamaica, since there is no extant specimen from Haiti. Christensen suggests[4] that what Plumier had was actually a form of the species commonly known as *Dryopteris submarginalis.*

Ctenitis vellea is distinguished from all other West Indian members of *Ctenitis,* except *C. submarginalis* (L. & F.) Copeland, by having pinnate-pinnatifid (rather than at least bipinnate-pinnatifid) fronds. From *C. submarginalis* it differs by its much smaller, scalier, rather dimorphic fronds, and by the rhizome-scales being entire and having a pocket-like base. The former species has scales which are always more or less toothed, and are flat at the base. It is known in the West Indies only from Hispaniola. Typically, these species are not dimorphic, but in the plant under consideration the fertile fronds are somewhat contracted. It is interesting to speculate that the extremely rare genus *Atalopteris,* known to science from less than a half-dozen specimens (supposedly representing 3 species!), may have arisen directly from *C. vellea,* or at least have been derived from the same stock. Such a possibility is supported by the weak (or incipient?) dimorphism of this species, for one of the features of *Atalopteris* (as distinguished from *Ctenitis*) is its pronounced dimorphism. And it may be noted that the sterile fronds of *A. Maxoni* (Christ) C. Chr. (the only Jamaican representative of its genus, and collected but twice) and of *C. vellea* are very similar.

Ctenitis vellea is a beautiful and distinctive species, and deserves to be better known. It am not surprised that Jenman thought it worthy of cultivation at Castleton Gardens, but it seems strange that it has been so nearly lost sight of since his day.

SCIENCE MUSEUM, INSTITUTE OF JAMAICA.

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[4] Kungl. Sv. Vet. Akad. Handl. **16**[2]: 33. 1937.

Shorter Note

SELAGINELLA RUPESTRIS IN GREENLAND.—In Meddelelser om Greenland, 147, no. 3 (1948), Dr. Tyge W. Böcher records a very striking extension of range. Near the southern tip of Greenland a great fiord runs far inland; near its head, some 80 kilometers from the sea, there is a considerable lateral valley in which, during the war, the United States had a military air-field. In this valley, on dry shelves of rock in very thin soil, *Selaginella rupestris* (L.) Spring was found in such quantity as to form the dominant element in the vegetation of the shelves.

Hitherto, the northeastern known limit of this species has been Nova Scotia. A number of other species, of relatively southern range otherwise, occur in Greenland; but their nearest stations on the mainland of North America are in Newfoundland or southern Labrador. In the case of the *Selaginella,* the gap is unusually wide.—C. A. WEATHERBY.

Recent Fern Literature

The New Gray's Manual.[1]—The eighth edition of Gray's Manual of Botany, issued 100 years after the first edition and 42 years after the seventh edition, has recently appeared. It represents the life work of one of the most distinguished of American botanists, Professor M. L. Fernald. Professor Fernald's productivity during the last forty years has amazed botanists. A continuous stream of papers from his pen has appeared in Rhodora and elsewhere. The end result of all this work now appears in the new Manual, which includes also a vast amount of material which has not been previously published.

[1] Gray's Manual of Botany. Eighth (Centennial) Edition Illustrated. Largely rewritten and expanded by Merritt Lyndon Fernald. pp. i–lxiv, 1–1632, many figs. American Book Company, New York, 1950. $7.60.

Professor Fernald's work has always been outstanding for its attention to bibliographic detail and for accuracy in observation. It is not to be expected that all taxonomists will agree with Fernald either in nomenclatural matters or in specific delimitations. The reviewer believes, to pick one instance, that few botanists will approve the adoption of Bartram's names, such as *Heracleum maximum*. Such names should be considered hyponyms. But Fernald's work will certainly have to be carefully considered by all working on the plants of the eastern United States.

The treatment follows the seventh edition rather closely as to typography and general format. The important generic and specific characters are placed in italics, as before, a helpful procedure. A much larger number of forms and varieties are recognized (The category subspecies is not used). The illustrations are in general by no means equal to the text in quality.

One praiseworthy feature, not carried out consistently in most manuals, is the recognition of indebtedness in certain genera to the work of other authors. Thus in the treatment of *Salix* mention is made of help received from the work of Schneider, in *Rumex* to that from Rechinger, and in other cases too numerous to mention. However, in very few, if any instances, has Professor Fernald copied the work of other authors exactly; he has always considered it critically. These supplementary references, given in footnotes, will be useful in leading the student to more detailed revisions and discussions than appear in the Manual.

The treatment of the ferns and fern allies is conservative. Dr. Fernald has never considered himself as a "pteridologist," although he has studied the ferns of the manual range and has published notes on them from time to time. The reviewer disagrees with Professor Fernald on some taxonomic points, some of which will be mentioned elsewhere. A few minor criticisms may be noted.

The key to genera is not always wholly accurate or usable. *Dryopteris* and *Polystichum* are said to have the "indusium peltate or attached at its center, orbicular to reniform"; to the reviewer "attached at its center" is synonymous with "peltate" and is not properly descriptive of *Dryopteris,* which has the indusium attached at a point on one side and not in the "center." *Pellaea, Notholaena, Cheilanthes,* and *Cryptogramma* are said to have the "rhizome very short" (as opposed to *Pteridium,* with "rhizome elongate, forking and extensively creeping), but *Cheilanthes lanosa* (*C. vestita* of Fernald's treatment) has a forking, creeping rhizome, and *Cryptogramma Stelleri* an even more elongate one. *Pellaea* is distinguished from *Notholaena, Cheilanthes,* and *Cryptogramma* solely by having the "pinnules and segments of the frond articulated at base." This is sure to be a stumbling block to the user, for this character is not obvious, and the reviewer is doubtful if it is true at all.

Keys are provided for most of the genera. However, there is inconsistency in the treatment of genera with two species only. Some, as for instance, *Cryptogramma, Woodwardia,* and *Pellaea,* have no keys, and others, like *Adiantum* and *Polypodium* do. This is evidently not due to certain species being more easily distinguished than others, for surely *Adiantum pedatum* and *A. Capillus-veneris,* or *Polypodium virginianum* and *P. polypodioides,* which are keyed, are more easily distinguished than *Pellaea atropurpurea* and *P. glabella,* which are not keyed.

It can not be presumed that the new Manual says the last word on the flora of the eastern United States. Much remains to be learned, both about the taxonomy and the distribution of our plants; doubtless, Professor Fernald will himself continue to add to our knowledge. But the Manual is certainly a landmark in the history of plant taxonomy and is a "must" for all serious students. C.V.M.

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R. C. BENEDICT IRA L. WIGGINS

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American Fern Journal

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The Chemical Composition of Certain Ferns and Fern Allies of Central Pennsylvania

Hsioh-Yu Hou[1]

Certain ferns and fern allies normally occur on acid soils, whereas others appear to be intolerant of acidity and grow on neutral or calcareous soils (Wherry, 1942). The former are frequently referred to as calcifugous and the latter as calcicolous plants. Other species are essentially indifferent to soil reaction.

A chemical study, with special reference to the aluminum, iron, manganese, phosphorus, calcium, and potassium content, of several species which grow on soils of contrasted pH values has been undertaken. It was hoped to obtain in this way a possible explanation as to why individual species thrive only on soils with a limited range of reaction.

Materials and Methods

All the plants investigated were collected between July 8 and July 25, 1948, in central Pennsylvania. The samples were dried for 48 hours at a temperature of 60–70° C. in a steam heated oven. The dried samples, after grinding, were ashed in Pyrex beakers at approximately 550° C. overnight. The small amount of carbon remaining present was destroyed by perchloric acid digestion.

The calcium and potassium were determined by the use of a flame photometer (Toth *et al.*, 1948). Alumi-

[1] The author is indebted to Dr. F. G. Merkle and Dr. J. P. Kelly, of Pennsylvania State College, for their invaluable assistance and guidance throughout this work.

[Volume 40, No. 3, of the Journal, pp. 201–232, was issued September 21, 1950.]

num, iron, manganese, and phosphorus were determined colorimetrically by means of the Coleman Spectrophotometer. Aluminum was determined by the use of the aluminon method (Winter *et al.*, 1929; Peech and English, 1944). Iron was determined by the o-phenanthroline method (Saywell and Cunningham, 1937). Manganese was determined by the simplified periodate method (Willard and Greathouse, 1917). Phosphorus was determined by an adaptation of the method of Fiske and Subbarow (1925).

CALCIFUGOUS SPECIES

1. LYCOPODIUM CLAVATUM (Running clubmoss). One chemical characteristic of this species is a high content of aluminum, which varies with the soil condition. The plants growing in site 1 and site 2 contain 0.2633% and 0.0790% of aluminum on a moisture-free basis, or 6.24% and 2.43% of aluminum on the ash basis respectively. The aluminum content of this species growing in site 1 is thus about three times that of the plant growing in site 2, which corresponds with the latter site being on peat soil, which is known to have a poor supply of aluminum (Magistad, 1925).

2. LYCOPODIUM FLABELLIFORME (Running pine). This species is characterized by the highest content of aluminum among the plants investigated: 0.7925–0.7613% of aluminum on the moisture-free basis, or 15.23–15.75% on the ash basis.

3. LYCOPODIUM OBSCURUM DENDROIDEUM (Round-branch ground-pine). This species also contains a large amount of aluminum. The plants growing in the three sites contain, respectively, 0.1230%, 0.1962%, and 0.3711% of aluminum on the moisture-free basis, or 10.72%, 6.48%, and 11.35% of aluminum in the ash. Again the one containing the smallest amount of aluminum was growing on the peat soil.

TABLE 1. The chemical composition of certain ferns and fern-allies most frequently growing on acid soils (per cent on moisture-free basis)

Site no.	pH of soil	Plant part analyzed	Ash	Al	Fe	Mn	P	Ca	K
1. Lycopodium clavatum									
(1)	4.1	Whole plant	4.23	0.2633	0.0278	0.0318	0.1382	0.1196	1.1960
(2)	3.3	Whole plant	3.25	0.0790	0.0168	0.0366	0.1146	0.0988	1.0277
2. Lycopodium flabelliforme									
(1)	3.8	Whole plant	5.02	0.7925	0.0141	0.0103	0.1177	0.0712	1.1961
(2)	3.5	Whole plant	4.79	0.7613	0.0113	0.0230	0.1378	0.0503	1.1481
3. Lycopodium obscurum dendroideum									
(1)	3.9	Whole plant	3.07	0.3290	0.0244	0.0116	0.1257	0.1225	0.8358
(2)	3.3	Whole plant	3.34	0.1692	0.0172	0.0156	0.0903	0.1015	0.5903
(3)	4.0	Whole plant	3.20	0.3711	0.0112	0.0192	0.1546	0.0816	0.8569
4. Dennstaedtia punctilobula									
(1)	4.2	Pinnae	9.00	0.0472	0.0329	0.0515	0.1789	0.4896	2.5061
		Stipe & rootstock	5.01	0.0263	0.0118	0.0172	0.1604	0.1787	1.6853
(2)	4.8	Pinnae	9.78	0.0402	0.0451	0.0518	0.2522	0.3591	2.9075
(3)	3.4	Pinnae	9.53	0.0276	0.0172	0.2961	0.1892	0.5044	3.3097
		Stipe & rootstock	5.00	0.0047	0.0032	0.0950	0.1158	0.1330	1.9569
5. Phegopteris hexagonoptera									
(1)	5.4	Pinnae	11.72	0.0231	0.0173	0.0104	0.2772	0.9804	2.0780
6. Osmunda Claytoniana									
(1)	5.3	Pinnae	8.90	0.0340	0.0100	0.4388	0.3821	0.6921	2.0780

4. DENNSTAEDTIA PUNCTILOBULA (Hay-scented fern). This species is characterized by a relatively large amount of manganese, which varies markedly with the soil condition. The manganese content of the plants collected in site 3 is about six times that of plants growing on the other two sites. This result corresponds with the lowest pH being exhibited by the soil of site 3; for it has been shown by many investigators that, as the pH of the soil decreases, the availability of manganese in the soil increases.

5. PHEGOPTERIS HEXAGONOPTERA (Southern beech-fern). No special chemical feature of this species has been found, although it is somewhat high in ash content.

6. OSMUNDA CLAYTONIANA (Interrupted-fern). This species contains 0.4388% of manganese on the moisture-free basis, or 1.31% of manganese on the ash basis, a percentage greatly exceeding all the other plants analyzed.

The chemical composition of the ferns and fern allies mentioned above is shown in Table 1.

CALCICOLOUS SPECIES

7. CYSTOPTERIS BULBIFERA (Bulblet-fern). It is notable that this species is very low in manganese content, and by far the highest in calcium content of all the plants studied.

8. PELLAEA ATROPURPUREA (Hairy cliff-brake). The lowest manganese content among all the plants examined is definitely shown by this species, which grows with its roots extending deeply into the limestone rock. Remarkably enough, however, it is not especially high in calcium.

The chemical composition of the above two calcicolous ferns is shown in Table 2.

INDIFFERENT SPECIES

9. DRYOPTERIS MARGINALIS (Marginal wood-fern). The analyses of samples of this species growing in two

TABLE 2. The chemical composition of two ferns growing most frequently on calcium-rich soils (per cent on moisture-free basis)

Site no.	pH of soil	Plant part analyzed	Ash	Al	Fe	Mn	P	Ca	K
7. Cystopteris bulbifera									
(1)	7.9	Pinnae	12.20	0.0335	0.0371	0.0035	0.1757	1.8615	1.7297
8. Pellaea atropurpurea									
(1)	7.9	Pinnae	6.65	0.0221	0.0206	0.0023	0.1368	0.5893	1.6626

TABLE 3. The chemical composition of two ferns growing on soils with varying pH (per cent on moisture-free basis)

Site no.	pH of soil	Plant part analyzed	Ash	Al	Fe	Mn	P	Ca	K
9. Dryopteris marginalis									
(1)	4.9	Pinnae	7.39	0.0218	0.0095	0.0374	0.3099	0.7687	2.0431
(2)	6.3	Pinnae	7.34	0.0233	0.0222	0.0044	0.2334	0.8654	1.9671
10. Polystichum acrostichoides									
(1)	4.1	Pinnae	8.26	0.0240	0.0077	0.0377	0.2827	0.4786	2.4367
(2)	6.7	Pinnae	7.62	0.0189	0.0164	0.0038	0.2976	0.6700	2.1785
(3)	6.8	Pinnae	7.62	0.0318	0.0143	0.0032	0.2078	0.6660	2.2648

sites differing widely in pH show that there is no noteworthy difference in the aluminum, phosphorus, calcium, and potassium content. However, this species contains nearly nine times as much manganese yet half as much iron when growing on the strongly acid soil than on the slightly acid soil.

10. POLYSTICHUM ACROSTICHOIDES (Christmas fern). On comparing the results of analyses of plants growing in the three different sites, it is evident that a definite relationship exists between manganese and the pH of the soil. On the other hand, the greater absorption of iron takes place in soil having the highest pH value. The content of aluminum, phosphorus, calcium, and potassium is rather uniform among the plants in the three sites.

The chemical composition of the above two ferns growing in soils with varying pH is shown in Table 3.

DISCUSSION OF ELEMENTS PRESENT

ALUMINUM. Certain of the calcifugous plants, especially the three species of *Lycopodium*, are extraordinarily high in aluminum, whereas the aluminum content of some other calcifugous species is not significantly higher than that of the calcicolous ones. These findings are in agreement with those of Hutchinson and Wollack (1943), who referred to Lycopodiums as "biological accumulators of aluminum." In general, no definite correlation was found between the soil pH and the aluminum content in any one species.

IRON. No distinctive difference between the calcifugous and calcicolous ferns was found when iron is considered. However, more iron was absorbed by a given species when growing on a soil of the higher pH. This relation is shown not only in the two ferns of indifferent reaction, but also in the calcifugous ones.

MANGANESE. It is evident from the data presented that the manganese content of the calcifugous ferns is markedly higher than that of the calcicolous ferns, constituting the most pronounced chemical distinction between these groups. In addition, when the same species growing in different soils is considered, there is a definite correlation between manganese and pH, the lower the pH of the soil the greater the percentage of manganese in the plant.

PHOSPHORUS. Although no significant difference in phosphorus content of the calcifugous and calcicolous ferns has been found, the higher content of phosphorus in the plants, in some instances, was associated with a higher pH of the soil.

CALCIUM. The calcium content of the calcifugous ferns is not necessarily lower than that of calcicolous ones. However, there is an indication that more calcium occurs in a given species growing on the less acid soil. This is well shown in the two ferns of indifferent reaction.

POTASSIUM. No chemical distinction as to potassium was found between the calcifugous and calcicolous ferns. In the ferns of indifferent reaction, however, the higher the pH of the soil, the smaller the amount of potassium was found in the plant.

CONCLUSION

A tentative suggestion may be made that the ecological distribution of ferns and fern allies may not be related to the supply of iron, phosphorus, calcium, or potassium in the soil, inasmuch as no chemical distinction between calcifugous and calcicolous ferns has been found with reference to these four elements.

The distribution of certain calcifugous types, such as the lycopodiums, containing or requiring a large amount of aluminum, is most likely associated with the fact that in acid soils this element is highly available. The calcifugous behavior of most ferns and fern allies seems, however, to be connected with the relatively high availability of manganese in the acid soils. On the other hand, the calcicolous ferns may well be very susceptible to the toxicity of manganese, and so are not found growing on acid soils, while the indifferent species may be tolerant of manganese.

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PENNSYLVANIA STATE COLLEGE.

Notes on the Ferns of the Eastern United States

(concluded)

C. V. MORTON

ATHYRIUM FILIX-FEMINA (L.) Roth var. CYCLOSORUM (Ledeb.) Moore, Ind. Fil. 183. 1860. The Alaskan form of the lady-fern, which occurs also in Newfoundland and Quebec, has been commonly called var. *sitchense* Rupr. ex Moore, Ind. Fil. 183. 1860. It has been overlooked that Moore did not recognize var. *sitchense*. This name appears only in the synonymy of var. *cyclosorum*, a name attributed to Ruprecht by Moore. Moore was the first author to unite these two varieties, and since he adopted the epithet *cyclosorum* and placed *sitchense* in synonymy, he must be followed, provided that these two names do refer to the same variety. It seems possible that *cyclosorum* as delimited by Ledebour (and Ruprecht) included some material of typical *A. Filix-femina*, but it was mostly based on the same form as *sitchense*. Consequently *cyclosorum* is the legitimate varietal epithet. However, Moore was in error in attributing the combination to Ruprecht, for Ruprecht published it as *Athyrium Filix-foemina γ Athyrium cyclosorum*, a binomial nomenclature for subspecies contrary to the present International Rules of Nomenclature. The first valid publication is that of Ledebour[19] as *Asplenium Filix-femina γ cyclosorum*. As a subspecies, the plant ought to be known as *A. Filix-femina* subsp. *cyclosorum* (Ledeb.) C. Chr. in Hultén, Fl. Aleut. Isl. 50. 1937.

ATHYRIUM FILIX-FEMINA (L.) Roth var. MICHAUXII (Spreng.) Farwell. In 1917, Dr. F. K. Butters [20] published a detailed study of the North American lady-ferns.

[19] Fl. Rossica 4: 519. 1853.
[20] Rhodora 19: 170–202. 1917.

He concluded that two forms occurring in the eastern states could be distinguished from *A. Filix-femina* as species, one of more northerly range, *A. angustum* (Willd.) Presl, and one commoner in the south, *A. asplenioides* (Michx.) Desv. He has been followed by most fern writers since that time, but almost always with some reservations, for the two not only intergrade with each other where their ranges meet, but also both are decidedly similar in most important respects to typical European *A. Filix-femina.* I recall that two of our most experienced and conservative fern students, Dr. Maxon and Mr. Weatherby, both told me in conversation that they would prefer to regard these plants as merely varieties. Recently, Professor Fernald[21] has boldly and, I believe, justifiably, done just this.

The rootstock characters emphasized by Butters need confirmation by field study both in the United States and Europe. They are not evident in herbarium material. The presence of darkish reticulate spores in *A. asplenioides* does not indicate a character of specific importance, for similar spores are found in *A. Filix-femina* var. *californicum* Butters. The characters of frond shape and indusia hold fairly well, but may best be regarded as indicating only a partial differentiation resulting in regional subspecies. The tropical American and Asiatic representatives of this group need further study.

Dr. Wherry has protested[22] against the "lumping" of our lady-ferns, but he has not brought out any new characters distinguishing them. In fact his description of *A. asplenioides* f. *ellipticum* only serves to draw attention to the close similarity between *A. asplenioides* and *A. angustum.*

The varieties and forms of *A. angustum* that have been described do not appear to represent genetic entities.

[21] Rhodora **48**: 389–391. 1946.
[22] Amer. Fern Journ. **38**: 155–158. 1948.

Some are merely teratological states (such as f. *laciniatum*), some persistent juvenile states (var. *laurentianum*), and some ecological variants (e.g. the sun form, typical *A. angustum*). It is unfortunate that the well-known epithet *angustum* cannot be used in a varietal sense. However, as a variety it dates from February, 1860[23] and *Michauxii* dates, as a varietal epithet, from 1859.[24]

ATHYRIUM FILIX-FEMINA (L.) Roth var. ASPLENIOIDES (Michx.) Farwell. The choice of name for the southern lady-fern presents an unusual complication. Sprengel, in transferring *Nephrodium asplenioides* Michx. to *Asplenium* changed the name to *Asplenium Athyrium*, considering that the name *Asplenium asplenioides* would be unsuitable. Sprengel's name is illegitimate under the Rules as superfluous when published. However, when Mettenius considered the plant as a variety he used the name *Asplenium Filix-femina* var. *Athyrium*, and thus *Athyrium* is the oldest varietal name available. When the lady-ferns are referred to a genus *Athyrium*, as is universally done at present, the use of such a varietal epithet as "*Athyrium*" would be confusing and most unfortunate. Such a case as this must be very rare and is not envisioned in the International Rules. I think though that it may be assumed that the prohibition in Article 68, Section 3, against the repetition of the generic name as a specific epithet (tautonym) can carry over to epithets of subspecific or lower rank. The legitimate epithet is therefore *Athyrium Filix-femina* var. *asplenioides* (Michx.) Farwell.[25]

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[23] *Athyrium asplenioides* var. *angustum* Moore, Ind. Fil. 179. 1860.

[24] *Asplenium Filix-femina* var. *Michauxii* (Spreng.) Mett. Abh. Senck. Naturf. Ges. **3**: 243. 1859.

[25] Papers Mich. Acad. Sci. **2**: 13. 1923.

ASPLENIUM

A good many reputed hybrids have been noted in *Asplenium.* The best known of these is *A. Trudellii* Wherry, which is considered to be *A. montanum* × *pinnatifidum.* I cannot see that there is any real trace of *A. montanum* in it, at least so far as the type specimen is concerned. I regard it as the most highly developed state of *A. pinnatifidum,* the frond being pinnate-pinnatifid at base instead of merely pinnatifid as in typical *A. pinnatifidum. Asplenium Stotleri* Wherry, which is essentially bipinnate, is regarded by Dr. Wherry as *A. pinnatifidum* × *platyneuron,* but I cannot see how a hybrid between two essentially simply pinnate species could be bipinnate. I consider it very likely *A. Bradleyi* × *pinnatifidum.* On the other hand × *A. Gravesii* Maxon, which Dr. Wherry considers to be *A. Bradleyi* × *pinnatifidum,* seems to me to be more like *A. pinnatifidum* × *platyneuron.* These fundamental differences of opinion indicate that these questions will probably not be definitely settled until controlled artificial crosses can be made between the species.

An unusual form may be described as follows:

ASPLENIUM PINNATIFIDUM Nutt. forma **elongatum** Morton, f. nov.

Pinnis basalibus valde elongatis, fortasse interdum radicantibus.

Basal three of four pairs of pinnae elongate and long-tapering, after the manner of *Camptosorus rhizophyllus* f. *auriculatus.* These elongate pinnae may perhaps sometimes take root at the tip.

Type in the U. S. National Herbarium, no. 517,449, collected at Bowling Green, Kentucky, on moist sandstone cliff, August 21, 1892, by Sadie F. Price.

PHYLLITIS

In 1913 Dr. Copeland published a paper[26] entitled: "On Phyllitis in Malaya and the Supposed Genera Diplora and Triphlebia." In this paper he indicated that certain plants from the South Pacific that were currently referred to the genera *Diplora* and *Triphlebia* were not distinct from *Phyllitis.* Now in the new Genera Filicum he reverses himself on this statement, merging *Phyllitis* with *Asplenium* on the ground that these South Pacific species are not intimately related to typical *Phyllitis Scolopendrium,* but are so superficially similar as to make the recognition of *Phyllitis* impossible. His conclusion is justified in that in soral characters these species can hardly be distinguished from *Phyllitis,* yet they can be in other ways. The hart's-tongue fern has the clathrate scales and stelar structure of *Asplenium,* but the species of the South Pacific genus *Diplora* have the scales and steles of the *Athyrium* type. I consider *Diplora* to be allied to *Diplazium.* In fact *Boniniella,* a genus of this alliance also reduced to *Asplenium* by Copeland, seems to be hardly more than an aberrant *Diplazium* itself, for "scolopendrioid" sori are exceptional and "diplazioid" sori normal.

Admittedly, this question deserves more extensive study than I can give it at the present time. However, the existence of *Diplora* need not invalidate *Phyllitis* and I prefer to retain that name for the hart's-tongue fern. Evidently Professor Fernald agrees, for he also retains *Phyllitis.*

MATTEUCCIA

Recently in this Journal[27] Dr. Wherry has called the ostrich-fern "our most renamed fern," and it doubtless has this dubious honor, due to the uncertainty as to the proper generic name and also as to the distinctness of the

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[26] Phil. Journ. Sci. Bot. 8: 147–155. 1913.
[27] Amer. Fern Journ. 35: 128. 1945.

American plant from the European. There are four generic names to consider: *Onoclea* L. (1753), *Struthiopteris* Willd. (1809), *Pteretis* Raf. (1818), and *Matteuccia* Todaro (1866). There is no question of the validity of the genus *Onoclea,* but fern students usually consider now that the ostrich-fern is not congeneric with the sensitive-fern. The two are similar in many respects, especially in vascular anatomy and soral structure. The ostrich-fern differs chiefly in habit (erect rhizome with underground stolons and numerous fasciculate fronds) and in being free-veined. I believe the venation character is sufficient to justify generic recognition. The first generic name applied especially to the ostrich-fern is *Struthiopteris* Willd., but this is a homonym of *Struthiopteris* Scopoli (1760). Hultén has maintained *Struthiopteris* (Fl. Alaska and Yukon **1**: 19. 1941), but this can be done legitimately only by conserving the name, which is unwise because the older genus *Struthiopteris* Scop. has sometimes been taken for the deer-fern, *Blechnum Spicant,* and its allies, and thus some confusion could result.

Rafinesque's genus *Pteretis* is, I believe, untenable. It was a renaming of Willdenow's genus for the stated reason that *Struthiopteris* is composed of two words *struthio* (ostrich) and *pteris* (fern). This is not a valid reason, for by the International Rules (Art. 59) a name must not be rejected because it is badly chosen. Thus Rafinesque's name is illegitimate. It is true that *Struthiopteris* Willd., was in need of being renamed (because of its being a homonym), but that was not Rafinesque's reason. It may be claimed that this is a mere quibble, but if so it is worth while if it results in the rejection of the name *Pteretis,* which has been adopted by Fernald, Small, and some other American botanists, but which has little chance of world-wide acceptance. The name *Matteuccia* has a firm place in fern literature, both taxonomic and morphological, due to its adoption in Christensen's Index Filicum, and it may be considered the tenable generic name by strict application of the Rules.

Professor Fernald has maintained that the American ostrich-fern is specifically different from the European, but the differences he points out[28] are not convincing. Hultén who knows the European plants at first hand, writes (*loc. cit.*) "No doubt the population of the species in America is somewhat different . . . from the European, but I cannot see that the difference is so large that it justifies a specific separation. A wide variation in the characters concerned is found in the European specimens." The single significant character appears to be in the scales of the rhizome and stipe base,[29] which have a black central portion in the European specimens examined. Such scales are not seen in American specimens. This difference is not so important that the needs of taxonomy are not fulfilled by regarding the two populations as merely varietally distinct. The interests of plant geography are furthered thereby. It seems, therefore, that another new nomenclatorial combination is needed.

MATTEUCCIA STRUTHIOPTERIS var. **pensylvanica** (Willd.) Morton, comb. nov.

Struthiopteris pensylvanica Willd. Sp. Pl. **5**: 289. 1810.

Pteretis pensylvanica Fernald, Rhodora **47**: 123. 1945.

The plant called f. *pubescens* is not worthy of nomenclatural recognition. The rhachises of the ostrich-fern are not glabrous, as sometimes stated, but always bear white, jointed hairs, which vary from few to many (the f. *pubescens*). Alaskan specimens have particularly long hairs.

[28] Rhodora **17**: 161–164. 1915.

[29] As remarked by G. N. Jones, Amer. Midl. Nat. **38**: 97. 1947.

PELLAEA

PELLAEA ATROPURPUREA var. BUSHII Mackenzie. In 1914, Mr. F. L. Pickett[30] called attention to two forms of the cliff-brake and gave a detailed discussion of their characters. He left the question of their nomenclature open, but in a later article[31] he came to the conclusion that the smaller, more northern form ought to be regarded as distinct under the name *P. glabella* Mett. In this he was followed by Dr. F. K. Butters,[32] and most recent authors, including Wherry, Small, Rydberg, and Fernald, have followed suit.

It must be admitted that there is a good deal of justification for this viewpoint. Nevertheless, the differences between these forms are by no means constant, and are chiefly of a quantitative rather than qualitative nature. The most constant character is the more glabrescent stipe and rhachis of *P. glabella,* but hairs are present in varying abundance, and these are identical with those of typical *P. atropurpurea.* The rhizome scales of *P. glabella* are somewhat broader and slightly different in color. It is claimed by Pickett that they are 10 to 20 cells wide at base and that those of *P. atropurpurea* are only 2 to 10 cells wide, but it is not hard to find scales of typical *atropurpurea* 20 cells broad. For the rest, *P. glabella* is on the whole smaller and less divided.

The characters stated are on the whole not coordinate with the characters separating undoubtedly distinct species of *Pellaea,* such as *P. intermedia* or *P. sagittata.* It seems probable to me that typical *P. atropurpurea* is a tetraploid race, although I know of no cytological data, more vigorous and widespread than *P. glabella,* and not intergrading because of its apogamous reproduction.[33]

[30] Amer. Fern Journ. **4**: 97–100. 1914.
[31] *Op. cit.* **7**: 3–5. 1917.
[32] *Op. cit.* 77–87. 1917.
[33] Cf. W. N. Steil, Apogamy in Pellaea atropurpurea. Bot. Gaz. **52**: 400–401. 1911.

When regarded as a variety, the proper name for *P. glabella* is *P. atropurpurea* var. *Bushii* Mackenzie. The diminutive form of South Dakota, Montana, and Wyoming is *P. atropurpurea* var. *occidentalis* E. Nels. (*P. pumila* Rydb.).

Pellaea dealbata (Pursh) Prantl. When I was writing up my account I consulted with the late Mr. C. A. Weatherby concerning the disposition of the plant usually called *Notholaena dealbata.* Mr. Weatherby was recognized as the chief (in fact, only) authority on the genus. He replied February 23, 1948, "In spite of the fact that Dr. Maxon and I kept *Notholaena* for it [i.e. *dealbata*], I would, in a manuscript like yours, follow Prantl and put *N. dealbata* into a section of *Pellaea,* defining the genus on habit, type of rhizome and scales, elongate sorus, and generally rugose spores. Some day, when phylogenists get around to it, the group will appear as the genus *Argyrochosma* (J. Smith). It is easily defined."

Later, in March, 1949, when I was working on the ferns for the second edition of Dr. Kearney's Flowering Plants and Ferns of Arizona, I again wrote him about this group of plants, and he replied: "I think it would be wholly correct to transfer *Notholaena limitanea* to *Pellaea;* only I think *N. Jonesii* should go with it. The presence or absence of ceraceous indument seems to be no more important than the presence or absence of any other epidermal outgrowth and in habit, structure of sorus, scale characters and spores it agrees with the species Prantl put into *Pellaea.* In fact, this is one of the two groups (and the better of the two) which I can see clearly as a segregate genus. If to the group of *N. nivea, N. dealbata, N. Fendleri,* et cetera, you add *N. Jonesii, N. Lumholtzii, Pellaea microphylla,* and *P. formosa,* you get a coherent and, I think, natural group, which as a genus, should bear the name *Argyrochosma* (J. Smith). I may live to publish on this.

"The second genus which I might maintain is for the group of *N. trichomanoides,* ranging in habit from that species to *N. Schaffneri,* and characterized by pectinate scales and the presence of ceraceous indument, which, in this case, is constant. This is not so clear as the other, but might stand.

"For the rest, I can so far see only a welter of forms which might conceivably be segregated into a dozen or fifteen microgenera, but which I should prefer to leave for the present in one polymorphic genus or in the two conventional ones, *Cheilanthes* and *Notholaena.* Actually, with the exception of a few species, the groups hitherto referred to *Notholaena* do not fit well with anything in *Cheilanthes. Aleuritopteris* suffers from the fact that neither Ching nor Copeland, both experts on oriental ferns, have attempted to define it in regard to American species. As they have it, the sole character which keeps such a species as *N. Standleyi* out of *Aleuritopteris* is the absence of a false indusium. Copeland's reference to a reflexed margin is, I think, misleading. It is not the reflexing which is significant, but the modification of the margin into a hyaline band.

"As to the Arizona species, *N. sinuata* is a true *Notholanea,* if there is any such thing, at least if you take *N. Marantae* as the type of the genus, and I think even if you follow Copeland in taking one of the Australian species. It has, like *N. Marantae,* more or less elongate sori and rugose-reticulate spores, an association of characters which is pretty constant, and, I think, has been too much neglected by Prantl and Copeland. *Notholaena Parryi* I should be inclined to put into *Cheilanthes.* The others would, for the purposes of a local flora, probably best be left in their conventional place in *Notholaena.*"

I followed up Mr. Weatherby's informative letter by saying that I intended to accept his recommendations, and asking if he did not wish to make the necessary transfers himself, but he never replied to this. Doubtless, he felt that he was not ready to do so. Since however some name must be used for these species in Dr. Kearney's publication, I venture to make the following new combinations, admitting that I can add little or nothing to Mr. Weatherby's summary of the situation. The whole question is highly involved.

PELLAEA **limitanea** (Maxon) Morton, comb. nov.
Notholaena limitanea Maxon, Amer. Fern Journ. **9**: 70. 1919.

PELLAEA LIMITANEA var. **mexicana** (Maxon) Morton, comb. nov.
Notholaena limitanea subsp. *mexicana* Maxon, Amer. Fern Journ. **9**: 72. 1919.

PELLAEA **Jonesii** (Maxon) Morton, comb. nov.
Notholaena Jonesii Maxon, Amer. Fern Journ. **7**: 108. 1917.

PELLAEA DENSA (Brack.) Hook. This species has troubled taxonomists for many years. It has been variously referred to *Onychium, Pellaea, Cryptogramma,* and *Cheilanthes,* but perhaps it does not really belong in any of them. I am using the name *Pellaea* until someone makes a definitive study of its relationships.

CHEILANTHES

In the new Illustrated Flora I use the name *Cheilanthes lanosa* (Michx.) D. C. Eaton in its accustomed sense. Professor Fernald decided that the plant originally described as *Nephrodium lanosum* Michx. was not the hirsute species that has commonly been associated with the name, but the more southern, densely woolly species known as *C. tomentosa* Link. He therefore changed the application of the name *C. lanosa* to the tomentose species, and called the hirsute species *C. vestita* (Spreng.) Swartz. As Dr. Wherry has rightly pointed out,[34] this confusing change is by no means certainly necessary. As Dr. Fernald admits, the specimens in the Michaux Herbarium belong to the hirsute species, but he maintains that these specimens have been mislabelled, basing this assumption solely on Michaux's use of the descriptive words "*totum lanosissimum.*" As is well recognized, the concepts of descriptive terms among botanists are highly subjective matters, and it does not seem beyond reason that Michaux would call the fronds of the hirsute plant "*lanosissimum.*" As Dr. Wherry pointed out, after all the indument is not really fundamentally dissimilar. As a matter of fact, the original description of *Adiantum vestitum* Spreng., the basis of *Cheilanthes vestita,* the name adopted by Fernald for the hirsute plant, also strongly suggests *C. tomentosa* in the statement that the blades are tripinnate and covered with fine, woolly hairs on both sides. It seems better to regard the named specimen in the Michaux Herbarium as authentic until the contrary can be convincingly demonstrated. It is unfortunate that Dr. Fernald has maintained his position in the new Manual, for this is bound to lead to confusion in the use of the name *C. lanosa.*

Dr. Wherry indicates that the easiest way to distinguish between *C. tomentosa* and *C. lanosa* is in the cutting of the blade rather than in the pubescence. There is a difference in cutting, but there are more important and obvious differences. The stipe and rhachis of *C. tomentosa* bears numerous flattened linear scales in addition to the hairs, whereas those of *C. lanosa* are hairy only. The rhizome of *C. tomentosa* is condensed and multicipital, but that of *C. lanosa* is elongate and creeping, with the fronds more or less scattered.

SMITHSONIAN INSTITUTION.

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[34] Amer. Fern Journ. **37**: 77–79. 1947.

Notes on Dicranopteris emarginata[1]

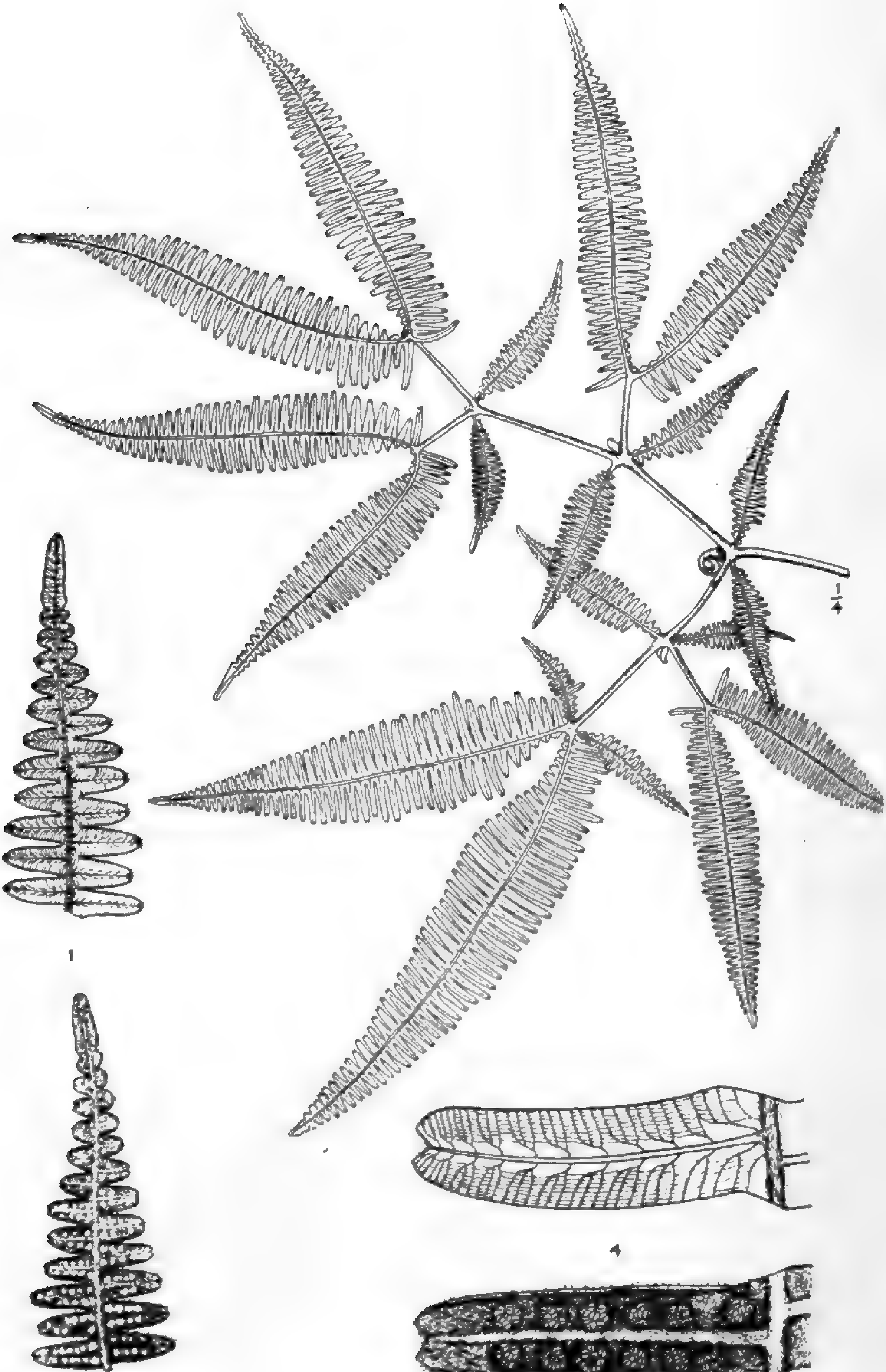
ALEX D. HAWKES AND OTTO DEGENER

At least four species of the Gleicheniaceous genus *Dicranopteris* Bernh. grow in the Hawaiian Islands. These interesting ferns, known locally as *uluhe* or False Staghorn Fern, are *D. glauca, D. linearis, D. owhyhensis,* and *D. emarginata.* It is with the last of this group that we wish to deal in this paper.

Dicranopteris emarginata was originally described in 1854 by Brackenridge as *Mertensia emarginata* (not to be confused with *Mertensia emarginata* Raddi, 1825). Since that time it has been known under several names, now all reduced to synonymy under *D. emarginata* (Brack.) Robinson. These are the following: *Gleichenia emarginata Moore* (1862), "*Gleichenia emarginata* (Brack.) Hbd." MacCaughey (1918), *Gleichena dichotoma* var. *tomentosa* Luerss. ex Wawra (1875), *Gleichena dichotoma* E. Bailey, pro parte (1882), *Gleichenia dichotoma* var. *emarginata* Hilleb. (1888), and *Dicranopteris sandwicensis* Degener (1940).

The *uluhe* fern is now known to be native to the islands of Hawaii, Oahu, Maui, Kauai and Lanai, where it often grows rampantly in a variety of situations. It is a tomentose species which is readily distinguished from the much more common *D. linearis* by its hairy fronds. The muricate, basally slightly villous stipes measure about a meter high in most instances, though when they are supported by entangling vegetation they sometimes become twice or thrice as high. They branch profusely in the upper portions. The pinnules are rather fleshily coriaceous, and are covered below with a fulvous wool composed of branching hairs, but become glabrous with age. The ultimate pinnae vary from 9 to 23 cm. long and 4 to 7 cm. wide, and are elliptic-oblong to elliptic-lanceolate

[1] Taken in part from the writers' forthcoming "Plants of the Tropics," volume I.



DICRANOPTERIS EMARGINATA

in shape. The lateral pinnae are variable in dimensions, usually one third as long or as long as the ultimate ones, and are pinnatifid or more rarely dentate or subentire.

The bud produced in each fork of the frond is glossily castaneous and densely pubescent, and is enclosed between a pair of small ovate crenate foliar bracts. The sori are often close, borne in a single row on each side of the midrib of the pinnule on a raised punctiform receptacle; they are usually composed of eight or fewer sporangia. The veins are prominent above, and mostly two- or three-branched; they sometimes unite to form a costal areole.

The *uluhe* ferns, particularly *D. emarginata,* are among the most objectionable of all plants in many parts of the Eastern tropics. Their thickets may be so dense as to be impassable, and they kill out low-growing species which chance to fall within their range. When such tangled thickets become dry during periods of drought, a carelessly discarded cigarette or a neglected campfire may ignite them, thus starting a devastating forest fire.

When *Dicranopteris* grows in relatively open country, the numerous dormant buds on the fronds seldom develop further, and hence the fronds rarely exceed a meter or so in height. But in localities where shrubs and trees tend to shade the plants, these buds quickly awaken into growth to produce complicated frond systems that clamber in a virtually impenetrable mass over the obstructing vegetation to a height of three meters or more.

Furthermore, it is extremely difficult to control these rapidly growing ferns. They may be kept within bounds when found in small patches by continually digging up the growing, brittle rootstocks which hold with aggravating persistency to the soil. Or, if strong plants, such as various types of bamboos, can be planted among the *uluhe* thickets, the dense shade produced frequently kills out the ferns, but then difficulty is often experienced in controlling these gigantic grasses themselves!

Shorter Notes

A NEW STATION FOR MARSILEA QUADRIFOLIA IN ILLINOIS. —In October 1947, *Marsilea quadrifolia* L. was collected in Spring Lake, McDonough County, in the west central part of Illinois. It has been observed in subsequent years, but has not become abundant. Jones (1950) lists one previous collection for Illinois, in Vermilion County in the east central part of the state. Neither Muenscher (1944) nor Fassett (1940) indicate its occurrence in Illinois. Identification was made from sterile material. Specimens have been placed in the herbarium of Western Illinois State College and sent to the herbarium of the Illinois State Museum at Springfield.—R. MAURICE MYERS, *Western Illinois State College, Macomb, Illinois.*

LITERATURE CITED

FASSETT, N. D. 1940. Manual of Aquatic Plants.
JONES, G. N. 1950. Flora of Illinois. 2nd ed.
MUENSCHER, W, C. 1944. Aquatic Plants of the United States.

A FERN COMMUNITY IN PENNSYLVANIA.—Fern Society members may be interested in a rather unusual combination of plants found on Piney Island, which is located in the Susquehanna River about 25 miles south of Lancaster, Pennsylvania, and about 20 miles above Conowingo, Maryland. The island is owned by the Pennsylvania Water and Power Company. The site was located by Mr. Alexander N. Shealy and the author. The following species were all on one sheer cliff of schist facing east and southeast: *Pellaea glabella, Asplenium Trichomanes, A. pinnatifidum, Polypodium virginianum, Dryopteris marginalis, Dennstaedtia punctilobula, Rhododendron maximum, Aquilegia canadensis,* and *Mitchella repens.*—ANDREW SIMON, *7727 York Road, Towson, Maryland.*

Recent Fern Literature

Dr. R. E. Holttum, the distinguished fern student of the Botanic Gardens, Singapore, who is now connected with the University of Malaya, has published a paper entitled "The Classification of Ferns."[1] This is essentially a comparison of his own scheme of classification with that of Bower, Christensen, and Copeland. Dr. Holttum's earlier paper on classification was discussed briefly by Mr. Weatherby in the Journal.[2]—C. V. M.

Spores of *Selaginella* have been studied by Mrs. Alice F. Tryon.[3] The spores of all the species of the United States are described and photographed and tentative keys based on spore characters are given. The spores of the few United States species of the subgenus *Stachygynandrum* are all readily distinguishable, but a number of species of *Euselaginella* can not be separated by spore characters. These characters are not well correlated with the groups of species defined on habital characters.—C. V. M.

Two new handbooks have been received for review from G. P. Putnam's Sons, New York. "Field Book of Nature Activities"[4] gives instructions concerning supplies, collecting and mounting plants, photography, and identification of plants, and similar instructions are given regarding birds, mammals, reptiles, and insects. The work will make an ideal gift for the youngster and many

[1] The Classification of Ferns, by R. E. Holttum. Biological Reviews (Great Britain) **24**: 267–296. 1949.
[2] THIS JOURNAL **38**: 7–12. 1948.

[3] Spores of the Genus Selaginella in North America, North of Mexico, by Alice F. Tryon. Ann. Mo. Bot. Gard. 36: 413–431. *pl. 23–30*. 1949.

[4] Field Book of Nature Activities, by William Hillcourt. pp. 1–320, many figs. 1950. G. P. Putnam's Sons, New York. $3.95.

older readers will find much of value, simply stated. "Field Book of Seashore Life"[1] is by a well-known scientist, Dr. Roy Waldo Miner, Curator Emeritus, American Museum of Natural History. In contrast to the preceding work, the content of the present is fairly technical, and will appeal to the serious student of marine life (only animal life is treated). The territory covered is from Nova Scotia to Cape Hatteras, thus including all the temperate waters of the eastern seaboard.—C. V. M.

American Fern Society

The British Pteridological Society is again actively publishing the British Fern Gazette, after a lapse of ten years due to the war, under the editorship of the Rev. E. A. Elliot, who is also a valued member of the American Fern Society. The British Society was organized in 1891, two years before the Fern Society and the Gazette began publication in 1909, just one year before the Fern Journal. It is not published as frequently as the Journal, two numbers usually appearing in a year, and is somewhat informal in style. The articles deal mostly with British ferns, especially with the cultivated forms, but articles on exotic ferns appear occasionally. Rev. Elliot has written that he and the President, Mr. A. H. G. Alston of the British Museum (Natural History), will be glad to welcome members of the Fern Society if they should chance to be in England. Our own Treasurer, Mr. Allen, is a new member of the British Society, and others may wish to join. The Rev. Elliot is acting as Secretary at the present time.

Our new member Dr. E. R. Grose has informed us of the untimely death of Robert Marshall Tetrick, II, on June 23, 1950. Mr. Tetrick, although extremely

[1] Field Book of Seashore Life, by Roy Waldo Miner. pp. 1–888, many figs. 1950. G. P. Putnam's Sons, New York. $6.00.

young (born June 9, 1929) had been interested in ferns for years and joined the Fern Society in 1946. He was recognized at the University of West Virginia, where he was a student, as an authority on ferns. He contributed a couple of short articles for the Journal, including the description of a new form of *Asplenium platyneuron*.

In the review of Gray's Manual in the last issue of the Journal the price was incorrectly quoted as $7.60. The American Book Company, 88 Lexington Avenue, New York, informs us that the price is $9.50, a very modest price indeed for such a large and useful book.

Mr. F. H. Sargent, 2423 North Underwood Street, Falls Church, Virginia, wishes to dispose of his collection of Puerto Rican ferns (265) and flowering plants (1483). This is a good representation of the flora of the island. The specimens are all named and mounted. The price is $275 for the lot or $20 per hundred. A sample will be sent on request.

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ERRATA

Page 18, line 24: For *callosus*, read *callosa*.
Page 19, line 10: For *Cetarachopsis*, read *Ceterachopsis*.
Page 142, line 26: For *semihastatum*, read *semihastata*.
Page 180, legend for plate: For Copeland 96, read Copeland 95.

American Fern Journal

A QUARTERLY DEVOTED TO FERNS

Published by the

AMERICAN FERN SOCIETY

EDITORS

C. V. MORTON

R. C. BENEDICT IRA L. WIGGINS

VOLUME 41

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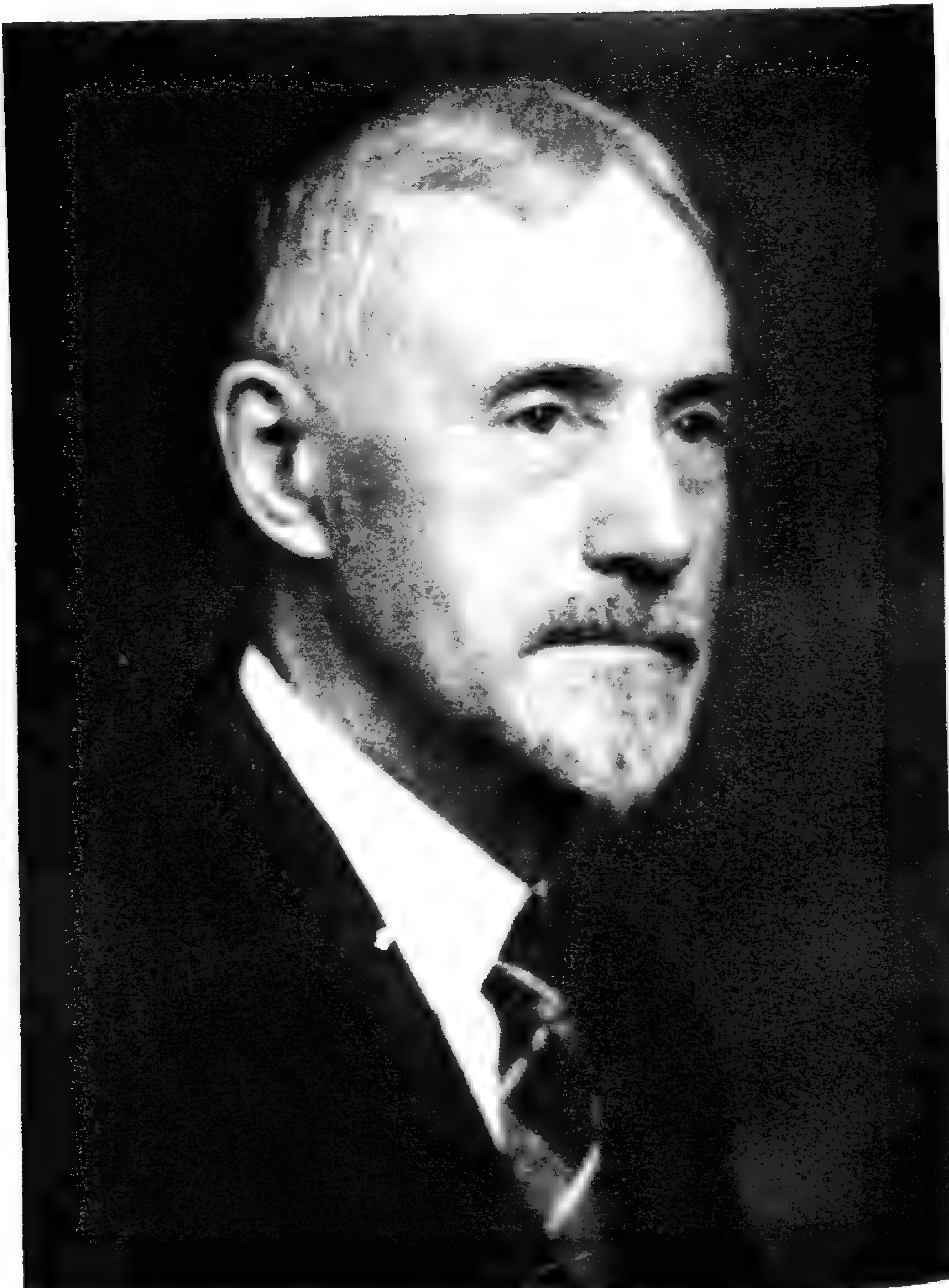

WILLARD NELSON CLUTE

American Fern Journal

Vol. 41 JANUARY–MARCH, 1951 No. 1

Willard Nelson Clute, 1869-1950

C. V. MORTON

Dr. Willard Nelson Clute was the virtual founder of the American Fern Society. He was born February 26, 1869, in Painted Post, New York (in Steuben County, about 80 miles south of Rochester), the son of George N. and Ruth Wright Clute. Clute has himself given us an account of the founding of the Fern Society, on the occasion of its fiftieth anniversary.[1] At the beginning in March, 1893, the Society had six members only, but there were 18 by the end of that year. A membership list of July, 1896, showed 31 active and 10 associate members (the distinction between active and associate members was later dropped).

Perhaps the first official act of the Society was the establishment of a magazine for the publication of papers and the interchange of news. This magazine, entitled "The Linnaean Fern Bulletin," was started in 1893, in the very first year of the Society's existence. Number 1 is a miniature-sized pamphlet of 12 pages, the first article being "Notes on Aspidium cristatum," by one of our two living charter members, Dr. Campbell E. Waters, this paper being a report on observations of phototropism in this fern. Clute's own article in this number, entitled "Travelling Ferns," gives evidence of his slant on fern study. It is an article dealing with methods of dispersal in ferns and shows Clute's interest in field botany

[1] Early Days of the American Fern Society. Amer. Fern Journ. **33**: 1–8. 1943.

[Volume 40, No. 4, of the JOURNAL, pp. 233–264, was issued December 29, 1950.]

and in making the results of his studies available in popular form. These interests persisted throughout Clute's lifetime and are especially in evidence throughout the lifetime of the Fern Bulletin.

The publication of the Fern Bulletin was rather a problem for the few members in the early years, for the dues were modestly set at $1.00 a year. Clute, who had been editor from the beginning, offered to publish the Bulletin himself. His offer was accepted; the Bulletin remained the official organ of the Society but Clute assumed all financial responsibility beginning with volume 5 (January, 1897). In this number Clute stated that the subscription price would be raised to 50 cents a year to allow for an increase in the size of the pages, in order, as he stated, "to dispel the idea (current in some quarters) that small pages must contain matter of small importance." The size of the page has since remained constant throughout the Fern Bulletin and its successor, the American Fern Journal. Under Clute's editorship the Fern Bulletin prospered and had at one time more than 700 subscribers, a number which has not been approached by the Fern Journal in recent years.

Clute was interested in taxonomy in his early years, being assistant curator of the Botany Department of Columbia University. He joined the staff of the New York Botanical Garden when that institution was founded. His early publications included "A Flora of the Upper Susquehanna Valley" (1898), "Our Ferns in Their Haunts" (1901), "The Fern Collector's Guide" (1902), and "The Fern Allies of North America" (1905). The latter is still the best semi-popular work on this group of plants.

From 1902 to 1928 Clute was teaching botany and agronomy in various high schools in Illinois. He went into his new work with characteristic energy and produced a number of textbooks that were widely used: "Laboratory Botany for the High School" (1909), "Agronomy for High Schools" (1912), "Laboratory Manual and Notebook in Botany" (1913), "Experimental General Science" (1917), and "Practical Botany" (1924).

In 1928 Clute was appointed to the staff of Butler University and was also Director of the new Botanical Garden of the University. He was highly enthusiastic about his new work and wrote to Dr. Maxon, "We are to have 1000 acres of park land, $3,500 a year for plants, and $90,000 for a building, to house library, auditorium, museum, art gallery, and conservatory. Now, if we have the brains, we shall astonish the world." Clute was evidently successful with the garden for in 1938, on his retirement from Butler University, he was made Director of the new Holliday Park Botanical Garden in Indianapolis. He wrote to Maxon, "We have an 86-acre tract along the White River . . . with three permanent streams and twenty or more springs. We ought to have a fine place. However, the PWA has done its worst and we will have to repair the damage," adding characteristically, "If you get this way, drop in and see us. It might be well to tell Washington scientists that there are positively neither Buffalo nor Indians here, so they can come without any risk."

Clute's most important works were published during the last 30 years of his life. They include "American Plant Names" (1923), "Useful Plants of the World" (1927), "Botanical Essays" (1929), "Common Names of Plants" (1931), "Swamp and Dune" (1931), "Off the Record" (1935) (a volume of verse), and "Our Ferns, Their Haunts, Habits, and Folklore" (1938). It is on the last-mentioned that his enduring fame will rest. It is by all odds the best fern-book for the amateur, sufficiently detailed that most of the common ferns may be easily identified and yet readable and filled with bits of out-of-the-way information.

Dr. Clute died, March 7, 1950, at the age of 81. He is survived by his wife, Ida Martin Clute, whom he married in 1897, and a daughter, Mrs. Beulah Rodecker.

The writer never had the pleasure of meeting Clute, whose personality must have been extremely vivid, for it comes through clearly in his writings, especially those in The American Botanist. With the demise of the Fern Bulletin in 1911 Clute's editorial activities did not cease. He continued to publish The American Botanist, in a way a unique periodical which went through more than 50 volumes. It was really a personal organ of publication, for by far the greater number of its papers were written by Clute himself. The subject matter varied, but was largely ethnobotanical and ecological, in a popular way. Clute's personality is expressed most clearly in his book reviews. He had a keen mind and at times an acid pen, especially in uncovering inaccuracies and pretentiousness. He had little use for the intricacies of nomenclature. However, the edge is taken from most of his comments by a whimsical and delightful sense of humor, which may be exemplified by one of his well-known remarks: "There are no sunflowers north of the Arctic Circle because when the sun once rises there, it continues to spiral upward and the sunflowers, following the sun, wring their heads off."

SMITHSONIAN INSTITUTION, WASHINGTON, D. C.

Notes on the Ferns of Kentucky, I. Dryopteris Goldiana

CLYDE F. REED

The distribution in Kentucky of Goldie's Fern is very incompletely known and the species is sparsely represented in herbaria. Since this fern is not evergreen and since the mountainous regions where it is most likely to abound are rather hazardous with posionous snakes in the summertime, a search may show that its distribution in this State is not so discontinuous and interrupted as records might lead one to think.

One of the first botanists to record the distribution of the ferns and fern-allies in the State of Kentucky was John Williamson,[1] who published the "Ferns of Kentucky" in 1878. Concerning Goldie's Fern he stated that he had found it in great abundance at that time near the Little Rockcastle River in Laurel County. This is the only locality definitely cited by Williamson. However, he did state that although this fern was somewhat rare in the less elevated portions of the State, it was not uncommon in the mountains.

Since that time no fern floras of this state appeared until Sister Greenwell's Flora of Nelson County,[2] in which no mention is made of Goldie's Fern. In 1938, Thomas McCoy,[3] in his "Ferns and Fern-allies of Kentucky," gives a few more definite county records for this fern. Again, the fern is designated as rare, and only three of the 120 counties in the state are mentioned—

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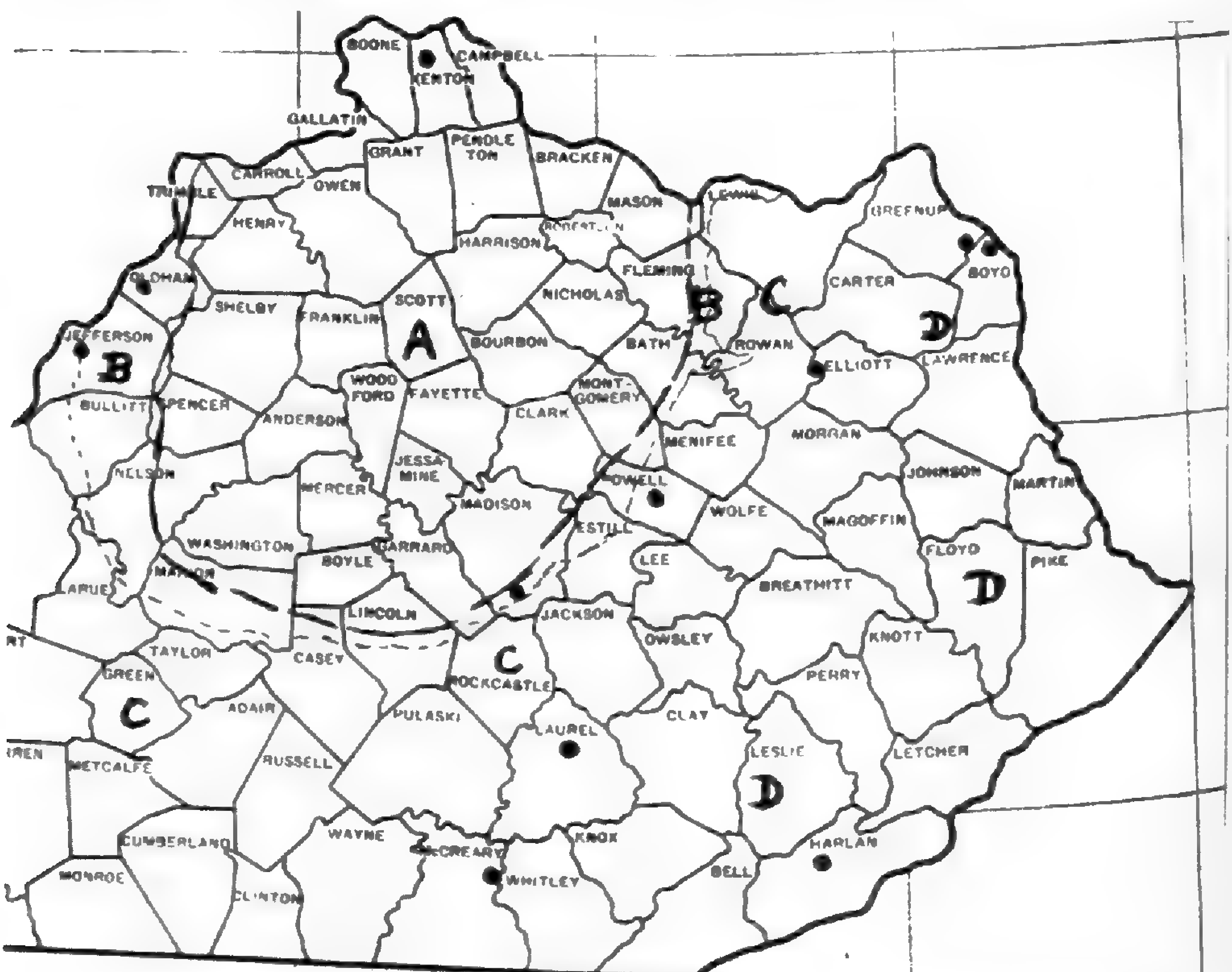
[1] Williamson, John. Ferns of Kentucky, with Sixty full-page Etchings and Six Wood Cuts, Drawn by the Author, illustrating Structure, Fertilization, Classification of Genera and Species. 95 pp., pl. I–XXXIV. 1878.

[2] Greenwell, Sister Rose Agnes. A Flora of Nelson County, Kentucky. Catholic Univ. of Amer. Biol. Ser. No. 20. 1935.

[3] McCoy, T. N. Ferns and Fern-allies of Kentucky. Amer. Fern Journ. 28(3): 103. 1938.

Boyd, Harlan and Kenton. These counties are widely dispersed in the state, Boyd County being near Ashland in the northeastern corner, Harlan County in the extreme southeastern corner, and Kenton County in the vicinity south of Covington near the Ohio River in the north central part of the state.

McFarland,[4] in his "Catalogue of the Vascular Plants of Kentucky," does not give any county distribution, but merely lists it as occurring in the state. However, in recent correspondence with Dr. McFarland several interesting localities have come to light. McFarland states that the fern grew near the tunnel of Natural Bridge, in



DISTRIBUTION OF DRYOPTERIS GOLDIANA IN KENTUCKY. A. ORDOVICIAN LIMESTONE; B. THE KNOBS, SILURIAN AND DEVONIAN; C. MISSISSIPPIAN; D. PENNSYLVANIAN.

[4] McFarland, Frank T. A Catalogue of the Vascular Plants of Kentucky. Castanea 7(6–7): 79. 1942.

Powell County, abundantly a few years ago. Due to the cutting over of this area and to the drying out of soil, along with the lack of shade, the plants are fewer there now. He also observed it in the region of Cumberland Falls (Whitley and McCreary Counties) in deep damp woods.

Collections in the Gray Herbarium and the United States National Herbarium indicate a wider distribution of Goldie's Fern in Kentucky. In Greenup County, near the Boyd County line, specimens have been taken. This locality adds to McCoy's collection from Boyd County, mentioned above. Also a Howell specimen from Catlettsburg (USNH) adds to Boyd County distribution. Specimens from Berea are not too distant from those of Williamson's locality in Laurel County, and are in a line with the drainage of the Rockcastle River and Cumberland River up to McFarland's locality at Cumberland Falls in Whitley and McCreary Counties. A specimen is also available from Oldham County (Gray Herb.), and another from Louisville (USNH), in Jefferson County, which is next to Oldham County.

To these localities I wish to add another which seems to tie the Boyd-Greenup localities in with the several localities farther west in Powell, Madison, Laurel, Whitley, and McCreary Counties. In southeastern Rowan and northeastern Elliott Counties along the boundary line of these two counties along the Caney Creek drainage numerous specimens of Goldie's Fern have been found in damp woods below a limestone outcropping. Also, along the North Fork of Triplett Creek, about three miles north of Morehead, in central Rowan County, more than thirty large plants were found in low damp woods, again below limestone ledges.

Except for the specimen from Kenton County, no specimens of Goldie's Fern are available from the Inner or Outer Bluegrass Area. This entire area is Ordovician.

On the periphery of this formation both the Silurian and Devonian are exposed and the specimens from Oldham, Jefferson, and Madison Counties are found in these formations. The specimens from Powell, Laurel, Rowan, and Elliott, and possibly those from McCreary and Whitley, Counties are found in the Mississippian formations of the Carboniferous. The specimens from Greenup, Boyd, and Harlan Counties are in the Pennsylvanian of the Carboniferous. Thus, this fern is found in Kentucky in four distinct geological formations.

Specimens in the herbarium of the University of Kentucky were destroyed by fire in 1948, and the specimens in T. N. McCoy's herbarium not distributed to other herbaria previously were destroyed by flood in 1937. Therefore, no specimens from Laurel, Whitley, and McCreary Counties have been examined by me. There are, no doubt, some duplicate specimens elsewhere, but to date I have not come by them.

I wish to thank C. V. Morton, of the U. S. National Herbarium, and Dr. Reed Rollins, of the Gray Herbarium, for supplying data from their herbaria.

SPECIMENS AVAILABLE OR SEEN: BOYD: Booger Rocks, in deep leaf mold along a sandstone cliff, Sept. 5, 1934, *T. N. McCoy* (Herb. Morehead State Coll.); Alley Woods, Sept. 10, 1935, *T. N. McCoy;* Catlettsburg, July 28, 1910, *A. H. Howell* 636 (US). GREENUP: "Big Woods," 3 miles from Boyd County Line, July 5, 1937, *L. B. Smith et al.* 3546 (Gray, US). HARLAN: Harlan, July 6, 1934, *A. N. Leeds* (Acad. Sci. Phila.). JEFFERSON: Louisville, July, 1854, *Charles Mohr* (US). KENTON: Banklick Creek, July 6, 1934, *T. G. Lea* (Acad. Sci. Phila.). MADISON: Dogfoot Spring, east of Berea, July 7, 1937, *L. B. Smith et al.* 3601 (Gray). OLDHAM; Near Prospect, June 14, 1942, *H. Bishop et al.* 33 (Gray). ROWAN: 3 miles east of Elliottsville, just off Hogtown Ridge, in deep wooded ravine down Caney Creek, over limestone soil, Nov. 20, 1949, *C. F. Reed* 18242 (Reed Herb.); woods along North Fork of Triplett Creek, 3 miles north of Morehead, June 4, 1950, *C. F. Reed* 20251 (Reed Herb.). Without specific locality: *C. W. Short* (US).

MOREHEAD STATE COLLEGE, MOREHEAD, KENTUCKY.

A New Species of Diellia from Oahu

W. H. WAGNER, JR.

The Hawaiian fern genus *Diellia* is represented by such local and variable populations that the species-taxonomy is unusually difficult. It is probable that each population is distinctive genetically and morphologically. Unlike so many of the familiar leptosporangiate ferns its life-cycle appears to be entirely sexual. It therefore lacks the general uniformity that characterizes such obligate-apogamous ferns as *Pellaea atropurpurea* and *Pteris cretica*. A small, isolated population of *Diellia* will probably tend to acquire unique features by a combination of random fixation and selection by the factors of a particular environment. Of the few populations which really do seem to merit specific recognition, that at Pohakea Pass, Oahu, discovered by D. L. Topping some twenty years ago, seems to represent one of the most distinctive species in the genus. Its ensemble of distinctive features makes it necessary that it be described as a new species. For help in studying this population I am indebted to Harold St. John, H. L. Lyon, E. B. Copeland, and Lincoln Constance.

DIELLIA **unisora** Wagner, sp. nov.

D. rhizomate erecto, 0.4–1.0 cm. crasso, 0.5–3.0 cm. longo, stipitibus rhachibusque multis gracilibus, atris; paleis minutissimis, 0.5–1.0 mm. longis, 0.3–0.5 mm. latis, nigris, pallide marginatis; frondibus linearibus, 8–30 cm. longis, 0.5–3.0 cm. latis; pinnis 20–35-paribus, 0.2–1.5 cm. longis, 0.2–0.7 cm. latis, oblique triangularibus; soris in marginibus acroscopicis pinnarum coadunatis.

Small fern of steep talus slopes, in beds of moss shaded by large tufts of grass. Fronds fasciculate, the leaf axes unusually persistent (plants with only 2–6 photosynthetic fronds sometimes having 10–40 additional per-

DIELLIA UNISORA. LYON HERBARIUM (*Topping* 3588) sistent rachises); rhizome narrow, erect, 0.5–3.0 cm. high, 0.4–1.0 cm. in diameter with the persistent leaf axes attached; scales few and very small, 0.5–1.0 mm. long, 0.3–0.5 mm. broad, occurring only on the rhizome and extreme bases of the stipes, the cells becoming totally occluded very early, their color jet-black except for 1–3 (rarely more) rows of distinct pale, thin-walled marginal cells; fronds linear, 8–30 cm. high, 0.5–3.0 cm. broad; stipes black and shiny, usually very narrow, 0.5–1.0 mm. in diameter, 2–5 cm. long; middle pinnae small, simple, remote, 20–35 pairs, 0.2–1.5 cm. long, 0.2–0.7 cm. broad at the base, usually strongly asymmetrical in outline, unequally triangular, the pinna attachment in line with the lower margin, the upper margin at first parallel to the rachis, then turning sharply along a line converging toward the lower margin; pinna margins mostly entire; frond tip gradually reduced (unlike fronds of similar size of *D. erecta* forms), very narrow, the pinnae ultimately becoming exceedingly minute; venation free to sparsely anastomosing along the margins, or the veins connected by a fertile marginal commissure along the anterior margin; sori usually a single marginal coenosorus running from the proximal end of the horizontal anterior margin to the middle or up to nearly the end of the pinna, occasionally separate, and occasionally borne also on the lower pinna margin, there usually distal; young sporophyte (only one seen) like those of the *D. erecta* group, but slightly smaller, the venation free at least up to the frond stage with two pinna pairs.

TYPE: Under tufts of grass, Pohakea Pass, Oahu, Hawaiian Islands, *Topping* 3740 (MO, no. 1,215,006).

DISTRIBUTION: Oahu, on steep, grassy, rocky slopes of the western side of the Waianae Range. Extremely local and rare.

SPECIMENS EXAMINED: Pohakea Pass, *Topping* 3588 (GH, NY, LYON, SM), 3740 (MO, type, US, NY), *Degener and Topping* 5630 (NY, MO, GH), *Wagner and C. St. John* 5800 (UC).

ILLUSTRATIONS: Smith, Occasional Papers B. P. Bishop Museum **10** (16): *fig. 3, pl. 6B*. 1934.

This tiny species of *Diellia* is now well represented in herbaria. Its salient distinctions from all other species and forms of this genus are the following: (1) completely occluded rhizome paleae of extremely small size, (2) sori essentially confined to the anterior pinna margins, (3) soral fusion, (4) retention of numerous persistent narrow rachises, and (5) delicate fronds gradually and symmetrically reduced at the apex. From the plant known as *D. pumila* it is amply distinguishable. The latter shows clathrate paleae, discrete sori on both pinna margins, spreading habit with few persistent stipes, and frond with rounded pinnae and terminated by a well-defined apical "pinna." The characteristics of *D. unisora* were tested by growing a pair of plants in a damp greenhouse for a year alongside other populations. While the plant called *D. pumila* changed its habit and characteristics rather radically under these conditions, those of *D. unisora* remained unchanged. It is therefore concluded that the morphology of *D. unisora* is fixed genetically.

Diellia unisora is one of four species of this genus, each of which is confined to a single island. *D. Mannii* and *D. laciniata* are confined to Kauai, while the present species and *D. falcata* occur only on Oahu. The fifth species of *Diellia*, however, is much more widespread and polymorphic, and ranges the length of the high islands of the archipelago. We are greatly indebted to the late Mr. D. L. Topping, who came to Hawaii with considerable fern-collecting experience gained in the Philippine Islands, and whose sharp eye discovered new localities for *D. falcata*, the single known locality for the present species, and records of various other interesting ferns on Oahu. It is to be regretted that he did not spend a month or two vacationing in the quiet and beautiful park area at Kokee, in western Kauai, where there are many miles of rolling, wooded, rocky gulches, the most extensive area known in the islands which is suitable to the habitat requirements of *Diellia*. It was here, some eighty years ago, that Valdemar Knudsen discovered such spectacular examples as *Diellia Mannii, D. centifolia,* and many, still mysterious varieties. Although I have spent many weeks hiking along the scenic trails through these many valleys, I was not lucky enough to run onto the particular slopes where these ferns grow. This is an event which is being saved for some fortunate botanist—in the course of his professional studies, or merely while on vacation. Hunting *Diellia* will probably remind that botanist of studying the rare spleenworts, and the habitat is very similar. Only when the particular hillsides that Knudsen alone knew of are rediscovered will the still unsolved problems of *Diellia* be clarified.

GRAY HERBARIUM, HARVARD UNIVERSITY.

Observations at Bartholomew's Cobble

EDGAR T. WHERRY

Driving through Sheffield, Massachusetts, recently, I took occasion to follow the signs pointing to Bartholomew's Cobble, written up so interestingly by the late Mr. Weatherby.[1] Entering the reservation, I observed clumps of *Selaginella rupestris* growing on exposed rock ledges. In the course of many years of study of the soil-reaction preferences of plants, I had made repeated tests on this spike-moss, and never found it in soils of less acidity than "subacid," (active acidity 50, pH 5.5). Correspondingly it was totally absent from limestone rock outcrops. Could an exception to this rule be represented here? Application of the point of a steel knife-blade immediately gave the answer. When one scratches limestone, a conspicuous white powdery groove is produced; siliceous rocks, on the other hand, rub off fragments of the steel, which show up as a dark streak

[1] This Journal **37**: 1. 1947.

on the white or pale background. This simple test showed that the outcrops of the Cobble are not wholly of limestone, as had been stated or inferred; a not inconsiderable number of them consist of milky-white vein-quartz, a rock composed dominantly of silica, in the pockets of which acid soils accumulate. In every case the clumps of *Selaginella rupestris* proved to be on such siliceous material. Tests with a soil-acidity indicator showed, too, that the humus accumulated in hollows under the trees of the Cobble was locally subacid in reaction, and supported such plants as *Polygala paucifolia*, which prefer this type of environment.

In recent times some ecologists have questioned the reality of the view that soil reaction has any bearing on plant distribution and have even "proven" by application of some advanced mathematical calculations that such is not the case. Their mathematics is faultless, but the premises are not. When one finds in nature a mosaic of areas of different soil reaction, certain species always grow on the circumneutral spots, others on the acid spots. The disseminules of all the species must fall on both types of area, but establishment of thriving colonies occurs only where the reaction suits the needs of a given sort of plant.

These remarks are published as a warning against drawing conclusions as to soil-reaction preferences of plants on the basis of superficial observations. Mr. Weatherby recorded that 276 species of flowering plants and ferns have been found in the 25 acres of the Cobble reservation, and no doubt sooner or later some one is going to assume that these are all "lime-loving" sorts. Now that we know, however, that the Cobble furnishes not only limey, circumneutral soils but also more or less acid ones, erroneous inferences as to the preference of individual species can be avoided.

UNIVERSITY OF PENNSYLVANIA.

A New Fern for the United States

LLOYD C. CRAWFORD

On October 15, 1949, Dr. A. M. Harvill and the writer made a trip into Winston County, Alabama. We stopped to examine some rock shelters formed in Pottsville sandstone along the southern edge of the West Fork of the Sipsey River about five miles east of Double Springs. Growing in fissures and along the ground we found a number of ferns such as *Trichomanes Boschianum* Sturm, *Asplenium pinnatifidum* Nutt., *Athyriuum asplenioides* (Michx.) Eaton, *Thelypteris normalis* (C. Chr.) Moxley, *Polystichum acrostichoides* (Michx.) Schott, *Osmunda regalis* L., *O. cinnamomea* L., and a specimen which was sent to Dr. Wherry for identification.

Dr. Wherry turned the identification over to Mr. George Proctor, who identified the specimen tentatively from Christensen's monograph of *Dryopteris* as *Dryopteris pilosa* (Mart. et Gal.) C. Chr. He took a few sprigs to the National Herbarium, where he and C. V. Morton compared it with Mexican material. They found it to match almost exactly a specimen of *D. pilosa* (determined by Maxon), collected near Mesa Correo, Chihuahua, Mexico, *LeSueur* 1144 (USNH 1,638,030). Mr. Morton and Dr. Wherry suggested the possibility of a new varietal status and Dr. Wherry suggested a new combination under *Thelypteris*.

A loan of specimens was requested from the National Herbarium and the Academy of Natural Sciences of Philadelphia, designated in this paper by US and PH respectively, for my study of this fern. Examining 41 specimens of Mexican and Guatemalan material, the writer found very little variation in specimens of *D. pilosa* and *D. pilosa* var. *procurrens* (Fée) C. Chr. except in size. *LeSueur* 1144, mentioned previously, and *Gentry* 2112, collected at Saguaribo on the Rio Mayo, Sonora, Mexico, growing on limestone rocks, showed the most variance and approached most closely my own collection from Winston County, Alabama.

Subsequent visits to the locality on November 27, 1949, with Mr. Charles Segars and on April 5, 1950, with Mr. Segars and Dr. Harold G. Rugg and Professor Norman Arnold of Dartmouth College have shown the fern to be evergreen and to produce spores all year.

All specimens of *D. pilosa* and *D. pilosa* var. *procurrens* examined, except *LeSueur* 1144 and *Gentry* 2112, have pinnae which taper to an acute tip and pinnae lobes that are somewhat pointed and recurving toward the axis with two basal veinlets running to the sinus. The Alabama fern shows no signs of acuteness but has rounded pinnae tips and pinnae lobes with only one basal veinlet running to the sinus. A consideration of these characters, which are comparable to the morphological features that delimit var. *major*, warrants a varietal status for the plant.

This species belongs in the section *Leptogramma* of the genus *Dryopteris*, which is now best considered as a section of the genus *Thelypteris*. The following new combinations are necessary.

THELYPTERIS **pilosa** (Mart. & Gal.) Crawford, comb. nov.

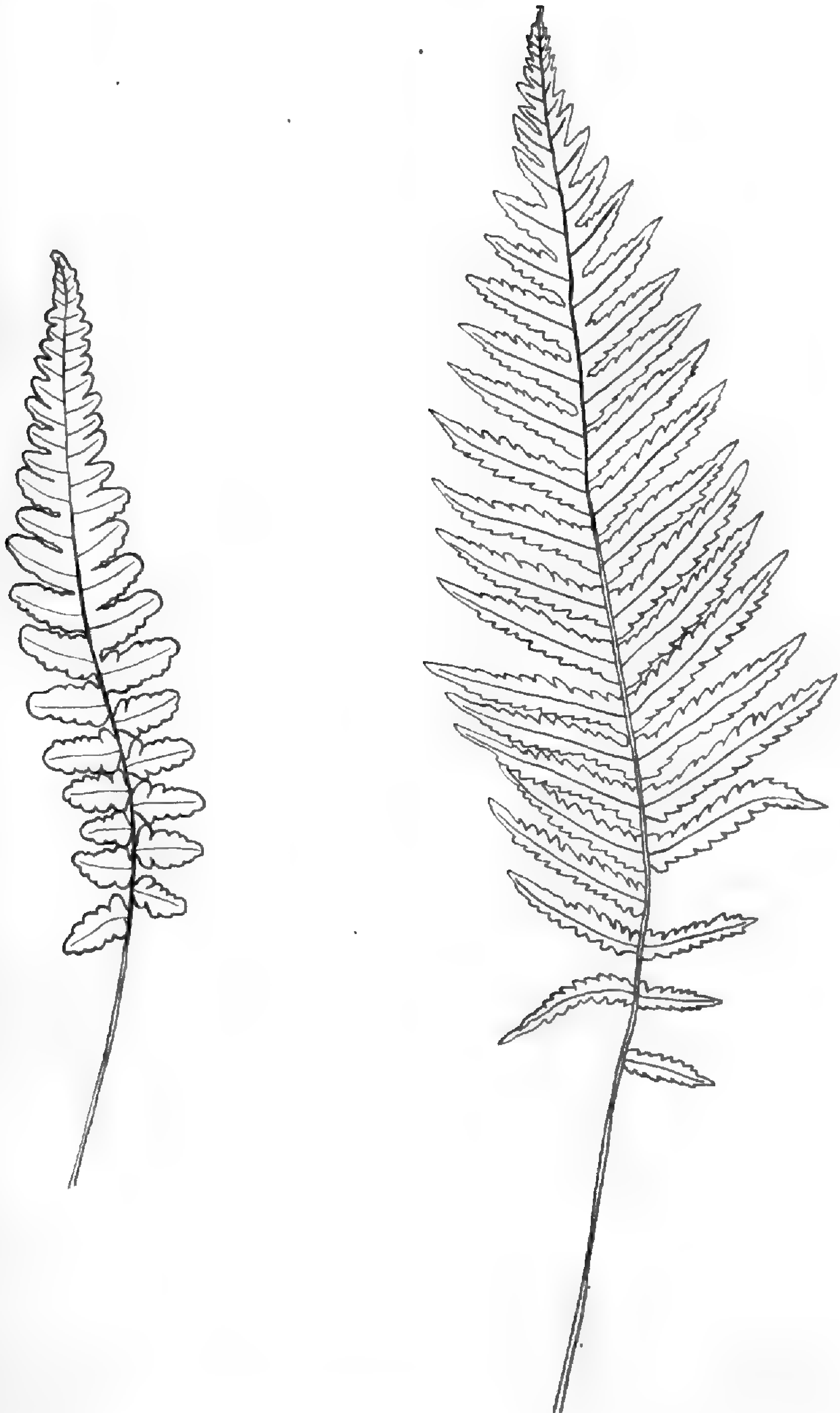
Gymnogramme pilosa Mart. & Gal. Mém. Acad. Brux. **15**: 27, *pl. 4, fig. 1.* 1842. Liebmann, Vid. Selsk. Skr. V. **1**: 181. 1848.

Dryopteris pilosa (Mart. & Gal.) C. Chr. Ind. Fil. 284. 1905.

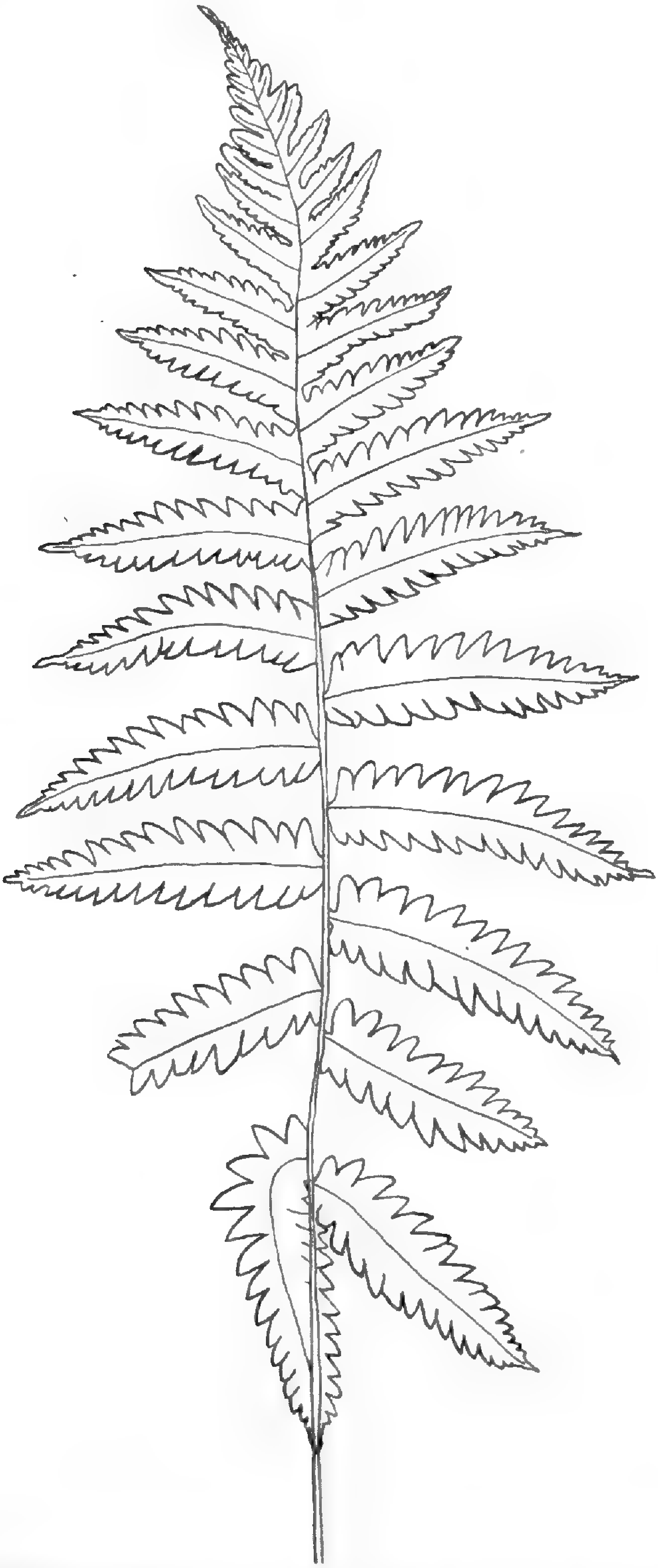
SPECIMENS EXAMINED:

MEXICO: JALISCO: Near Guadalajara, *Pringle* 2589 (US, PH),[1] 4094 (US), 9346 (US);[1] on Río Blanco, near Guadalajara, *Rose & Painter* 7502 (US).[1] PUEBLA: Finca Guadalupe, alt. 2125 m., *Arsène* 67 (US), 190 (PH); Manzanilla, *Arsène* (US). MEXICO:

[1] Specimen cited by C. Christensen.



Right: Thelypteris pilosa, one-half natural size (*Pringle* 2589, Guadalajara, Jalisco, Mexico); left: T. pilosa var. alabamensis, one-half natural size (*Crawford* 241, Winston County, Alabama)



THELYPTERIS PILOSA VAR. MAJOR, ONE-HALF NATURAL SIZE (*Conzatti & Gonzalez* 711, CERRO SAN FELIPE, OAXACA, MEXICO)

Popocatepetl, alt. 2850 m., *Broun* (PH); La Sierrita, Distr. Temascaltepec. *Hinton* 3467 (US). MORELOS: Sierra de Tepoxtlan, alt. 2250 m., *Pringle* 11265 (US).[1] MICHOACÁN: Morelia, Santa Maria, alt. 2000 m., *Arsène* (Rosenst. Fil. Mex. Exs. 48); Tancitaro, Uruapan, alt. 2000 m., *Hinton* 15659 (US); Falls of Tzararacua, *A. N. Leeds* 170 (PH). GUERRERO: Below Mina Santa Elena, Sierra Madre del Sur, Distr. Mina, alt. 1835 m., *Mexia* 9002 (US). CHIHUAHUA: Mojarachic, *Knobloch* 5047 (US); Creel, *Knobloch* 7042 (US).

GUATEMALA: QUICHÉ: Chichicastenango, *M. E. Leeds* (US, PH). ZACATEPEQUEZ: San Rafael, alt. 1950 m., *J. D. Smith* 2722 (US). CHIMALTENANGO: Barranco de La Sierra, southeast of Patzúm, alt. 2100 m., *Standley* 61518 (US). SAN MARCOS: Volcán Tajumulco, alt. 1800–2500 m., *Steyermark* 36791 (US).

THELYPTERIS PILOSA var. **major** (Fourn.) Crawford, comb. nov.

Gymnogramme procurrens Fée, Mém. Foug. **8**: 78. 1857.

Gymnogramme pilosa var. *major* Fourn. Mex. Pl. **1**: 73. 1872. Based on *G. procurrens* Fée.

Gymnogramma totta var. *G. procurrens* Baker in Hook & Baker, Syn. Fil. ed. 2. 515. 1874. Illegitimate form of publication.

Dryopteris pilosa var. *procurrens* C. Chr. Dansk. Vid. Selsk. Skr. VII. **10**[2]: 197. 1913. Illegitimate.

SPECIMENS EXAMINED:

MEXICO: OAXACA: Cerro de San Felipe, alt. 3000 m., *Conzatti & Gonzalez* 711 (US);[1] without special locality, alt. 1750 m., *Conzatti & Gonzalez* 3 (US).[2] MEXICO: Ixtaccihuatl, alt. 2400 m., *Purpus* 1603 (US).[2] DISTRITO FEDERAL: Contreras, *Lyonnet* 1632 (US); San Rafael Atlixco, *Lyonnet* 240 (US); Eslava, *Lyonnet* 3303 (US). MORELOS: Zempoala, *Lyonnet* 1415 (US); Valle del Tepeite, *Lyonnet* 2101 (US). HIDALGO: San Miguel Regla, *Lyonnet* 2009 (US); near Zacualtipán, alt. 1800 m., *Martinez* 17 (US).

GUATEMALA: CHIMALTENANGO: Chichavac, near Tecpam, alt. 2400–2700 m., *Johnson* (US), *Skutch* 666 (US).

THELYPTERIS PILOSA var. **alabamensis** Crawford, var. nov.

Frons 10–20 cm. longa; lamina lineari-lanceolata;

[2] Annotated by C. Christensen.

pinnae 0.5–1.5 cm. longa et 0.5–0.7 cm. lata; laminae, pinnae, et segmenta apice rotundatae.

Fronds 10–20 cm. long; blades linear-lanceolate; pinnae 0.5–1.5 cm. long and 0.5–0.7 cm. broad; apex of the blades, pinnae, and segments rounded.

Type in the herbarium of the University of Alabama, collected in fissures of Pottsville sandstone, West Fork of Sipsey River, 5 miles east of Double Springs, Winston County, Alabama, alt. 400 meters, October 15, 1949, by L. C. Crawford (no. 241). Isotypes in the U. S. National Herbarium and the Academy of Natural Sciences, Philadelphia. Another specimen from the same locality was collected Nov. 27, 1949 (*Crawford & Segars* 375, US).

ADDITIONAL SPECIMENS EXAMINED:

MEXICO: SONORA: Saguaribo, Río Mayo, alt. 1650 m., *Gentry* 2112 (US). CHIHUAHUA: Near Mesa Correo, *LeSueur* 1144 (US).

The writer wishes to express appreciation to E. P. Killip and C. V. Morton, of the U. S. National Herbarium, and to Dr. Francis W. Pennell, of the Academy of Natural Sciences, Philadelphia, for the loan of specimens used in this study, and to Dr. Edgar T. Wherry and George R. Proctor for other assistance.

UNIVERSITY OF ALABAMA, UNIVERSITY, ALABAMA.

Ferns of Iron Mountain, Rogue River Range, Oregon

WILLIAM H. BAKER

Iron Mountain is located in the Rogue River Range, on the Coquille-Rogue River Divide in Coos-Curry Counties. The mountain is 15 air miles from the Pacific Ocean and is directly east of Port Orford, Oregon. It is 10 miles north of the Rogue River and is the highest peak in the area, reaching an elevation of 4000 feet.

The geologic formations are great intrusive masses of granitic rocks bordered by metamorphics; slates, serpentines and marbles, with some older lavas, generally referred to as greenstones. In general they are Paleozoic and Mesozoic in age. In addition there are many basic intrusive masses of such rocks as peridotites. The topography of the region is broken and rugged due to excessive dissection and the nature of the formations, which are apparently old and heavily metamorphosed. The whole pattern is a maze of ridges and valleys, giving a very confusing topographic picture (2).

The boundaries of the mountain are limited as follows: the north slope to Sucker Creek Canyon at 3000 feet; northwest slope to Copper Mountain Canyon at 2000 feet; south slope to McCurdy Camp at 2700 feet; south slope to Bonanza Basin and the canyon of Boulder Creek at 2500 feet; southeast slope to Ophir-Iron Mountain saddle at 3500 feet; east slope to the south fork of Rock Creek at 2000 feet.

The area is drained by a number of streams. The south slope is drained by Boulder Creek and Foster Creek; the east slope by the North and South Fork of Rock Creek; the north slope by Sucker Creek; and the west slope by the South Fork of Elk River.

Specimens were obtained during the seasons of 1946, 1947 and 1948. All of the numbers cited are the author's own collections. Duplicates have been deposited in the University of Idaho Herbarium and in the Oregon State College Herbarium.

POLYPODIACEAE

POLYPODIUM GLYCYRRHIZA D. C. Eaton. Licorice-fern. Common on rocky outcrops of north slope near summit (no. 5476).

POLYPODIUM HESPERIUM Maxon. Mountain licorice-fern. Among rocks on northwest slope near summit (no. 4293); fairly common.

POLYSTICHUM MUNITUM (Kaulf.) Presl. Common sword-fern. Along Rock Creek on east slope at Smith Claim (no. 3017); very common.

POLYSTICHUM MUNITUM (Kaulf.) Presl. var. IMBRICANS

(D. C. Eaton) Maxon. Imbricated sword-fern. On east slope along Rock Creek (no. 3200); rocky northwest slope (no. 4906); on summit under rocks (no. 3214); common.

POLYSTICHUM MUNITUM (Kaulf.) Presl. var. INCISOSERRATUM (D. C. Eaton) Underw. Open east slope along Rock Creek (no. 3201); rare.

ATHYRIUM FILIX-FEMINA (L.) Roth. Lady-fern. East slope growing beside a spring (no. 3080); common.

BLECHNUM SPICANT (L.) Roth. Deer-fern. Common along springs and watercourses in deep shade. East slope near Smith Mine at a spring (no. 3249); on the shady southeast slope (no. 3116).

ADIANTUM PEDATUM L. var. ALEUTICUM Rupr. Western maidenhair. East slope along Rock Creek at Smith Claim (no. 3147); fairly common.

PTERIDIUM AQUILINUM (L.) Kuhn. var. PUBESCENS Underw. Western bracken. Along banks of Rock Creek at Smith Claim in moist woods (no. 3145); very common.

CHEILANTHES GRACILLIMA D. C. Eaton. Lace-fern. On rock ledges at summit (no. 3228); similar situations on the south slope (no. 3770); southeast slope (no. 3113); not uncommon.

CHEILANTHES SILIQUOSA Maxon. Oregon cliff-brake. Common on dry hillsides, east slope (nos. 3362, 3036); south slope (no. 5622); southwest slope (no. 3096).

CRYPTOGRAMMA ACROSTICHOIDES R. Br. American parsley-fern. Northwest slope near summit, among rocks (no. 4922); also common on steep rocky hillsides overlooking Boulder Creek on the south slope (no. 3744).

WOODWARDIA FIMBRIATA J. E. Smith. Giant chain-fern. Creek bottoms on southwest slope (no. 3085); occasional.

EQUISETACEAE

EQUISETUM TELMATEIA Ehrh. Giant horsetail. Along moist roadside margins at Smith Claim on Rock Creek, east slope (no. 5659); fairly common.

SELAGINELLACEAE

SELAGINELLA WALLACEI Hieron. Wallace's selaginella. On mossy rocks in open woods on south slope (no. 5646); also common at summit.

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UNIVERSITY OF IDAHO, MOSCOW, IDAHO

American Fern Society

Report of the President for 1950

The past year will be remembered chiefly perhaps for the issuance by the Society of the 168-page Weatherby Memorial number of its *Journal.* Along with the Maxon Memorial number the two symposia attest to the vigor and variety of mid-century interests centering in ferns. The work of Mr. Morton in the tedious editing of this number wins the appreciative thanks of the whole Society.

If this Society may be considered the "lengthened shadow of a man" that man would be Willard Nelson Clute (1869–1950), botanist, author, editor, professor, who was keen about natural history as a lad in his native valleys of New York State and held his enthusiasm until nearly his eightieth year. After founding this Society he served as its first president. His several books on ferns and fern study introduced thousands of persons, young and old, to the delights of the hobby.

The Seventh International Botanical Congress was held at Stockholm, Sweden, July 12–20, 1950, and Dr. A. C. Smith represented the Society as its official delegate. More than 1500 delegates attended besides many others like our Secretary, Miss Scamman, who found the lectures and excursions rewarding if sometimes hurried and tightly scheduled. More than 600 formal papers were presented in fourteen of the Congress Sections; abstracts of these will be published in the Proceedings of the Congress. Uppsala University, Linnaeus' botanical garden, and his estate in nearby Hammarby were visited; field trips to practically all parts of Sweden were arranged for the visitors. Several important small changes in procedures were voted upon by the delegates in the Section on Nomenclature, some of which affect the names of ferns. For example, the principle of repeating the specific epithet for any name of a taxonomic group (now called a taxon) of a rank below the species which includes the type of the species was adopted. Thus, when referring to the other varieties of *Dryopteris cristata* the "typical" variety must henceforth be called *D. cristata* var. *cristata*. This would seem to be a logical step in the right direction. The Society is indebted to Dr. Smith for his participation in the Congress on its behalf.

To Mr. Walter S. Allen, our retiring Treasurer, the Society owes a profound debt of gratitude for a job well done. Exacting and conscientious, Mr. Allen has served the Society through some of its most expensive years, and his many suggestions have added to its present financial vigor. His help, too, has been far beyond the call of his office.

Mr. M. D. Mann, Jr., our newly elected Treasurer, brings a varied background and a live interest in ferns—some of you know his fern garden!—to the service of the Society. By sending in your dues promptly you will help his work, all donated, and the many activities of the Society will benefit.

The sale of duplicates from the Society's library, cared for by Dr. Rolla Tryon, has benefited many purchasers and the organization's treasury. Our thanks go to Dr. Tryon and to those members who have donated books to the sale in a good cause.

This year the Society's annual meeting will be held in Minneapolis, Minnesota, in conjunction with the A. I.

B. S. convention, Sept. 10–13, 1951. An indoor program as well as a field trip is planned. It is not too early to prepare your talk for that program, and if you cannot thus favor us you will want to see the ferns of Minnesota afield. Plan to come!

JOSEPH EWAN, *President*

Report of the Secretary for 1950

It has been a pleasure to welcome 34 new members (including one Life Member) to the Society during the past year. These come from various sections of the country, especially from the South and Southwest, and they include, also, two from Canada, one from Cuba, and one from far-away China. Four annual members have become Life Members, increasing the number to 22.

The Society has lost by death seven of its outstanding members, who have been associated with the organization many years.

Professor Willard Nelson Clute, the founder of the Society in 1893 and its first President, died at his home in Indianapolis on March 7th. In 1934 he was made an Honorary Member of the Society. A biography will be found elsewhere in this number of the Journal.

The death of Professor Oakes Ames of Harvard was a great loss to students of orchids everywhere. He developed the Orchid Herbarium at Harvard, numbering more than 64,000 specimens, including more than 1000 species described by him. Although the study of orchids and work in economic botany were his chief interests he had been a member of the Fern Society since 1917.

Professor Fred A. Loew, who joined the Society in 1938, was associated with Huntington College, Indiana, much of his life, as student, Professor of Biology, and Director of the Arboretum and Botanical Garden there since 1932. His last annual report of the botanical garden gave a total of 612 species preserved and planted in the garden, including native Indiana ferns.

Ira Waddell Clokey's life is an inspiring story of a great plant collector. His herbarium of 102,600 specimens, including ferns, which he had built up by his own collecting as a mining engineer in Mexico and Colorado, and later through exchange after a fire had destroyed many of his early valuable specimens, is now incorporated in the University of California.

The sudden death of a young and promising fern student and member of the Society, Robert Marshall Tetrick, II, of West Virginia has been noted previously in the Journal.

Two faithful members of long standing in the Society have died during the year—Mrs. Ernest B. Dane, of Chestnut Hill, Massachusetts, who joined the Society in 1925, and Mrs. John R. Delafield, of New York City, a member since 1923.

The names of 35 have been removed from the list through resignations or non-payment of dues. This leaves a total membership, as of December 31, of 424, slightly less than last year.

At the time of the election of officers a year ago an amendment was added to the Constitution, providing for a Sustaining Membership, credited to any person upon the annual payment of five dollars. Our new Treasurer has sent out a notice, calling especial attention to this new type of membership. It is hoped that many will show their appreciation of the Society by helping in this way to meet the increased cost of printing.

The Society has had one meeting the past year, in Columbus, Ohio, in connection with the annual meeting of the American Institute of Biological Sciences. A symposium on classification of ferns of great interest was held September 12 under the auspices of the Fern Society and the American Society of Plant Taxonomists. The field trip in West Virginia was much enjoyed by all members who participated.

The Weatherby Memorial number has received much favorable comment. This largest single issue of the Journal ever published is a fitting tribute to a long-time officer of the Society and one of the most distinguished fern authorities and teachers in America. Both he and his wife, Mrs. Una Weatherby, have been staunch friends of the Society many years.

Letters received by the Secretary from members and would-be members reveal the desire of many for a wider knowledge of the native ferns in their native habitats, as well as of their cultivation in house and garden, and some are venturing into the fascinating field of raising ferns from spores.

Respectfully submitted,

EDITH SCAMMAN, *Secretary*

Report of the Treasurer for 1950

The Fern Society has had a good year financially. The heavy expense for the Weatherby Memorial number has been met by a very generous contribution from Mrs. Weatherby, supplemented by special gifts from many of Mr. Weatherby's friends and associates. The Society is very grateful for this assistance.

Five life memberships have been received and this income was deposited in the special Savings Bank account. No withdrawals have been made from the two special accounts or from the reserve fund. Nineteen members have added to our income by taking out sustaining memberships.

My sincere thanks go to the Council and the members of the Society for their many kindnesses, and I bespeak the same hearty cooperation with my successor.

Receipts	*Amount*	*Sub-total*	*Total*
Cash on hand Jan. 1, 1950			$ 982.21
1949 Membership arrears	$ 31.75	$ 31.75	
1950 Membership renewals	593.50		
1950 Sustaining members	95.00		

1950 New members	55.00	743.50	
1951 Membership renewals	43.10	43.10	
1952 Membership renewals	3.60	3.60	
1953 Membership renewals	1.60	1.60	
1949 Subscription arrears	1.50	1.50	
1950 Subscription renewals	109.20		
1950 New subscribers	26.50	135.70	
1951 Subscription renewals	135.65	135.65	
1952 Subscription renewals	1.50	1.50	
Life memberships	165.00	165.00	
Sale of back numbers A.F.J.	124.34	124.34	
Sale of A.F.J. cumulative index	1.02	1.02	
Sale of Vars. and Forms	1.00	1.00	
Sale of State and local ferns	1.85	1.85	
1950 Advertising	20.00	20.00	
Reprints	238.65	238.65	
Gifts for Weatherby Memorial No.	852.50	852.50	
Sale surplus library books	35.15	35.15	$2,537.41
			$3,519.62
Deduction a/c Agency commission (subscribers)*			25.20
			$3,494.42

* Deducted at source of subscription.

Disbursements	*Amount*	*Sub-total*	*Total*
Business Press, Inc.			
A.F.J. Vol. 39, No. 4	$263.36		
A.F.J. Vol. 40, No. 1	945.37	(Weatherby No.)	
A.F.J. Vol. 40, No. 2	275.46		
A.F.J. Vol. 40, No. 3	227.85		
		$1,712.04	
5000 printed envelopes	66.43	66.43	
Bank charge	.25	.25	
Reprints	266.68	266.68	
Recorder of Deeds, Wash'n, D. C. (certified Treas. statement)	.50	.50	
Life memberships (to special acc't no. 2)	165.00	165.00	
Expense			
President	1.64	1.64	
Treasurer	49.82	49.82	
Secretary	38.53	38.53	
Editor	19.44	19.44	$2,320.33
Cash on hand Jan. 1, 1951			$1,174.09

STATEMENT, DECEMBER 31, 1950

Assets

Cash on hand	$1,174.09	
In Spec. Account #1	545.53	
In Spec. Account #2	526.71	
In Reserve fund	1,493.01	$3,739.34
Inventory A.F.J.	500.00	500.00
A.F.S. Library	300.00	300.00
		$4,539.34

Liabilities

Capital Account	$3,021.70
Suspense Credit	
1951 membership	43.10
1952 membership	3.60
1953 membership	1.60
1951 subscription	135.60
1952 subscription	1.50
Distribution vol. 40, no. 4	260.00
Bissell Herbarium fund	545.53
Life Membership fund	526.71
	$4,539.34

Respectfully submitted,
WALTER S. ALLEN, *Treasurer*

Report of the Auditing Committee

We hereby certify that we have seen the books and accounts of the retiring Treasurer, Mr. Walter S. Allen, and have obtained from the banks confirmation of the correctness of the Society's balances which they are respectively holding, as set forth in detail in the accompanying statements of the Treasurer.

HENRY A. IMSHAUG
CLARENCE LEWIS
Auditing Committee

Report of the Judge of Elections

The results of the recent balloting for officers of the American Fern Society for the year 1951 are as follows:

For President	
Joseph Ewan	135
R. C. Benedict	1
For Vice President	
Dr. Donovan S. Correll	133
Dr. A. J. Sharp	1
For Secretary	
Miss Edith Scamman	132
For Treasurer	
M. D. Mann, Jr.	128
Walter S. Allen	2
W. E. Liggett	2

I therefore declare the following candidates elected to the several offices: President, Mr. Joseph Ewan; Vice-President, Dr. Donovan S. Correll; Secretary, Miss Edith Scamman; Treasurer, Mr. M. D. Mann, Jr.

Respectfully submitted,

RALPH S. EARLE, *Judge of Elections*

Report of the Curator and Librarian for 1950

The sale of the surplus books from the Library has continued but with diminishing returns as the titles most in demand were soon sold. The residue now consists mostly of broken sets of periodicals, a few older floras and manuals and miscellaneous reprints on mosses, fungi, birds and so forth. An effort will be made to dispose of this material through other channels.

Several members have used the facilities of the Library and Herbarium this past year and it is hoped that an increasing number will borrow books or specimens for study.

Mrs. Una F. Weatherby presented the Library with a valuable collection of reprints on ferns and also donated a number of specimens to the Herbarium. Some of M. L. Fernald's early collections from the Gaspé are an especially notable addition. Mr. Harold Rugg deposited a specimen of *Lygodium palmatum* collected in Vermont.

Respectfully submitted,

ROLLA M. TRYON, JR., *Curator and Librarian*

Report of the Ohio Meeting and Field Trip, 1950

The annual meeting of the Society was held in connection with the national meeting of the American Institute of Biological Sciences at Ohio State University, Columbus, Sept. 11–13, 1950. The indoor program took the form of a symposium on the subject of fern classification, with Dr. R. M. Tryon reporting on the history of the topic; Dr. N. Radforth, on the paleobotanical approach; Dr. E. B. Copeland, on a modern realignment of genera (paper read by Dr. Wagner), and a final paper on the genus *Diellia* by Dr. W. H. Wagner, Jr. This symposium was jointly sponsored by the Society, the American Society of Plant Taxonomists, and the Systematic Section of the Botanical Society of America, held on Monday afternoon, Sept. 11th, and was well attended.

An all-day field trip was planned for the Thursday following the general convention, Sept. 14th, to the fern ledges of the Sugar Grove region of Hocking and Fairfield Counties near Circleville. We found 33 species of ferns, five species of club-mosses, and *Selaginella rupestris*. Five rare ferns found were *Asplenium Bradleyi* and *A. Trudellii*, *Polypodium polypodioides*, *Pteretis nodulosa*, and *Trichomanes Boschianum*. Mr. Floyd Bartley, Ohio fern enthusiast, led the trip and William Goslin assisted with the arrangements on the O. S. U. campus. Though not as many persons made the trip as was expected, the twelve from Ohio, Michigan, and Tennessee who tramped the ravines were delighted with the "finds" and enjoyed the trip very much.

JOSEPH EWAN, for the *Secretary*

NEW MEMBERS

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Mrs. Mary F. Somerville, 978 Lincoln Way East, Chambersburg, Pennsylvania
Mr. Harry W. Trudell, 1309 Highland Avenue, Abington, Pennsylvania

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Vol. 41 April-June, 1951 No. 2

American Fern Journal

A QUARTERLY DEVOTED TO FERNS

Published by the

AMERICAN FERN SOCIETY

CONTENTS

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The American Fern Society

Council for 1951

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DONOVAN S. CORRELL, Mt. Pisgah Road, Avenel, Silver Spring, Md. *Vice-President*

MISS EDITH SCAMMAN, Gray Herbarium, Harvard University, Cambridge, Massachusetts *Secretary*

M. D. MANN, JR., 625 Locust St., Roselle, New Jersey *Treasurer*

C. V. MORTON, Smithsonian Institution, Washington 25, D. C. *Editor-in-Chief*

OFFICIAL ORGAN

American Fern Journal

EDITORS

C. V. MORTON .... Smithsonian Institution, Washington 25, D. C.
R. C. BENEDICT .... 1819 Dorchester Road, Brooklyn 26, N. Y.
IRA L. WIGGINS .... Dudley Herbarium, Stanford University, Calif.

An illustrated quarterly devoted to the general study of ferns.

Subscription, $2.00 per year, foreign, 10 cents extra; sent free to members of the AMERICAN FERN SOCIETY (annual dues, $2.00; sustaining membership, $5.00; life membership, $35.00). Extracted reprints, if ordered in advance, will be furnished authors at cost. They should be ordered when proof is returned.

Volume I, six numbers, $2.00; other volumes $1.25 each, except vol. 38, $2.00. Single back numbers 35 cents each through vol. 37; later numbers 40 cents, except vol. 38, no. 4, $1.00 and vol. 40, no. 1, $1.25. Ten per cent discount to members and institutions on orders of six volumes or more. Cumulative Index vols. 1–25, 25 cents.

Matter for publication should be addressed to C. V. Morton, Smithsonian Institution, Washington 25, D. C.

Orders for back numbers and other business communications should be addressed to the Treasurer of the Society.

LIBRARIAN AND CURATOR OF THE HERBARIUM

R. M. TRYON, JR., Missouri Botanical Garden, St. Louis, Mo.

A regular loan department is maintained in connection with the library and herbarium. Members may borrow books and specimens at any time, the borrower paying all postal or express charges. The pages of the Journal also are open to members who wish to arrange exchanges; a membership list is published at intervals, to assist those interested in obtaining specimens from different localities.

American Fern Journal

Vol. 41 April–June, 1951 No. 2

The Real Arctic and Its Pteridophyta

Nicholas Polunin

In his opening address to the session on "The Arctic Flora" held by the phytogeographical and main taxonomic sections of the Seventh International Botanical Congress at Stockholm, the present writer deplored the lack of precision in our conception of what the Arctic really is, and the lack of standardization and consistency in the use of the very common and necessary adjectival form of the word (Polunin, 9). The situation is little if at all better in pteridological than any other literature, for it is common for an author to term any plant (or its range) "arctic" that reaches a region which according to *his* conception constitutes part of the Arctic. But what this last is, where it begins and ends, unfortunately varies so greatly in different authors' minds that the whole concept has become at the best little more than relative—or, at worst, dangerously misleading. Nor is much help to be derived from such single criteria as the Arctic Circle, which in theory governs the presence or absence of "midnight sun," or from the common conception of the Arctic as a "cold desert": ferns do not thrive in deserts, but a fair number manage very well in indubitably arctic lands. The need thus remains for some definition or at least delimitation of the Arctic as a region, variable though it is in character in its different component parts, and vast in its far-flung entirety.

[Volume 41, No. 1, of the Journal, pp. 1–32, was issued April 10, 1951.]

To generalize may be easy but dangerous, to define difficult above all. But a start must be made somehow, and so, following rather many years spent in the exploration of various high-latitude lands and waters, the present writer has come to consider a certain set of criteria as being most useful in the separation of the truly arctic regions from those lying to the south. What he looks upon as the real arctic is thus delimited, provisionally but already usefully, and comprises in general those areas of land, fresh water, and adjacent sea "that lie north of whichever of the following is situated farthest north in each sector of the northern hemisphere: (1) a line 80 kilometers (50 miles) north of the northern limit of coniferous forest or at least more or less continuous *taiga,* i.e. terrain with sparsely-scattered trees, (2) north of the present-day northern limit of at least microphanerophytic growth (i.e. of trees 2–8 meters in height but excluding straggling bushes in unusually favourable situations), the northern extremities of tongues or outliers separated by not more than fifteen degrees of longitude being united across, or (3) north of the northern Nordenskiöld Line, which is determined by the formula $V = 9 - 0.1K$, where V is the mean of the warmest month and K is the mean of the coldest month, both in degrees Centigrade." In addition there are some local exceptions to consider and "smoothings out" to be effected to give a working basic line on a reasonably-scaled map.

For purposes of phytogeographical citation the land, especially, lying north of our arctic boundary may usefully be divided into ten sectors ranging eastward as follows:

I. Western Europe (from 10° W. to 40° E. longitude, including Jan Mayen, Bear Island, and the Spitzbergen Archipelago).

II. Northeastern Europe-northwestern Asia (from 40° E. to the midwaters of the Gulf of Ob, i.e. about 73° E. longitude, so including the Franz Josef Archipelago and Novaya Zemlya and the Islands and northernmost mainland lying to their south).

III. Western-central Asia (from the midwaters of the Gulf of Ob to Anabar River, i.e. about 113° E. longitude).

IV. Eastern-central Asia (from the Anabar River to near the mouth of Kolima River, i.e. about 162° E. longitude).

V. Easternmost Asia (from slightly northeast of the mouth of the Kolima to Bering Strait in about 169° W. longitude but excluding St. Lawrence Island).

VI. Alaska-Yukon (from St. Lawrence Island and westernmost Alaska to the northeastern extremity of Yukon Territory, i.e. about 136° W. longitude).

VII. Western arctic Canada (extending eastward to a line starting in the south just west of the west coast of Hudson Bay in latitude 60° N., and, to the north, skirting the heads of the inlets from Hudson Bay, proceeding through the midwaters of Prince Regent Inlet and Wellington, Belcher, and Sverdrup channels so as to retain Somerset, Cornwallis, and Cornwell Islands).

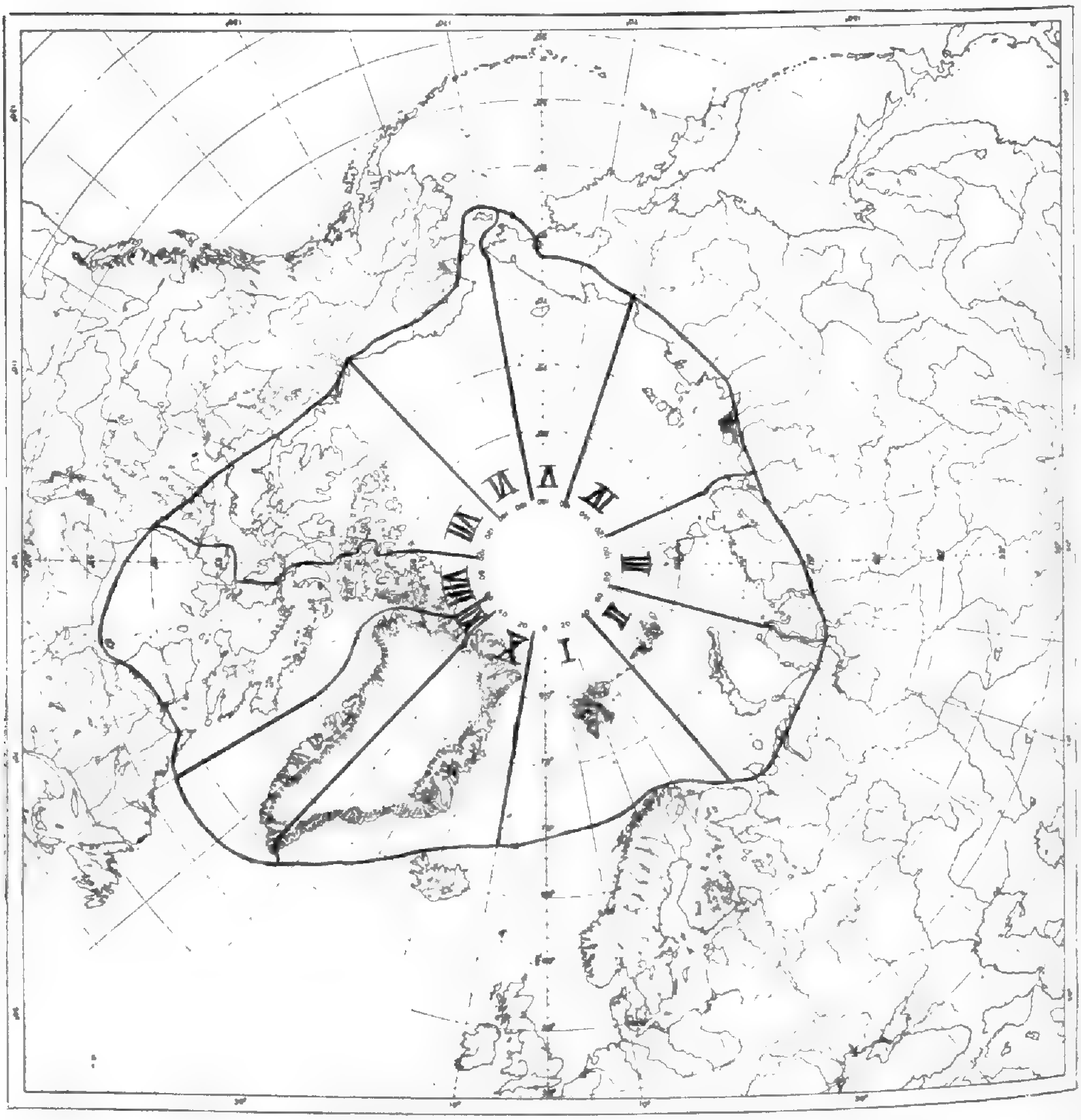
VIII. The Canadian Eastern Arctic (comprising the remainder of arctic Canada, including the whole of Melville Peninsula and Ellesmere, Axel Heiberg, Devon, Baffin, and Southampton Islands).

IX. West Greenland (including the islands of the extreme south, and the north coast eastward to Victoria Fjord—about 46° W. longitude).

X. East Greenland (comprising the remainder of that sub-continent).

The proposed delimitation of the Arctic and subdivision into sectors are indicated in the accompanying map.

AMERICAN FERN JOURNAL VOLUME 41, PLATE 5



MAP SHOWING THE DELIMITATION OF THE ARCTIC AND OF THE TEN PROPOSED SECTORS

It would seem unjustifiable to consider as truly arctic any plant entity that does not extend north of the southern boundary of the Arctic, and unwise to accept as truly circumpolar any taxon that is not known to occur in every major sector.

Although these proposals are tentative, they nevertheless seem to fulfil a need and afford a useful working basis, and will be adhered to in the present contribution, which may be looked upon as a first attempt to apply the suggestions advanced at the Stockholm Congress (Polunin, 9). From the regions north of the arctic-subarctic delimiting line so constituted, there have to date been confirmed the following 35 species of Pteridophyta, and it would seem that unless the criteria are changed or fresh data demand revision of the boundary, all other species of ferns and their so-called allies should for the time being be excluded from the arctic flora.

OPHIOGLOSSACEAE

BOTRYCHIUM BOREALE Milde (Northern Grape-fern) occurs in southern Greenland, on both the east and west sides. To this species belongs the source of the report of *B. simplex* Hitchcock from the Arctic, for, as already recorded, "A single plant in . . . Copenhagen, collected . . . by Jens Vahl . . . and labelled 'Aug. 1829 in locis graminosis sinus Tasermiut 60° 5',' was determined by Gelert as *B. simplex*. . . . It is the sole source of all subsequent reports of *B. simplex* from Greenland and 'the Arctic,' but actually belongs to *B. boreale*. Indeed, this is already clear from the illustration . . . in Ostenfeld's 'Flora Arctica,' which shows a branched and bushy fertile part of the frond, and, as an only character suggesting *B. simplex* (apart from a lamina which is misrepresented, being in the original specimen much more markedly pinnate), a rather low point of origin (a little less than half-way up) for the sterile part. However, this is a very variable character in *B. boreale*. . . . It is an even more variable character in *B. simplex* . . ." (Polunin, 8).

BOTRYCHIUM LANCEOLATUM (S. G. Gmel.) Ångstr. (Lance-leaved Grape-fern) likewise occurs in southern Greenland, on both the east and west sides, as has long been known.

BOTRYCHIUM LUNARIA (L.) Swartz (Moonwort) has so far been confirmed as reaching the Arctic only in eastern and western Greenland and eastern Europe but it is to be looked for in other sectors as it approaches our southern boundary in many places. In Greenland various sports may be found (Polunin, 8; Porsild, 10).

BOTRYCHIUM TENEBROSUM A. A. Eaton (Gloomy Grape-fern) is known in the Arctic only from a single collection made by the writer in 1937 in southwestern Greenland (Polunin, 8). If, as is nowadays frequently done, following Dr. R. T. Clausen (2), it is kept as a variety of *B. simplex*, that species can now after all be claimed for the Arctic (cf. above).

POLYPODIACEAE

ASPLENIUM VIRIDE Huds. (Green Spleenwort) occurs in southern Greenland, on both the east and west sides.

ATHYRIUM ALPESTRE (Hoppe) Ryl. agg. (Alpine Lady-fern) likewise occurs in Greenland, on both the east and west sides (specimens seen in Herb. Oslo, Copenhagen, etc.), and probably reaches the Arctic also in Eastern Europe.

CRYPTOGRAMMA STELLERI (S. G. Gmel.) Prantl (Slender Cliff-brake) reaches the Arctic in the eastern-central sector of Siberia (specimens seen in Herb. Stockholm).

CYSTOPTERIS FRAGILIS (L.) Bernh. *s.l.* (incl. *C. dickieana* Sim.) (Brittle Fern) appears to be circumpolar in distribution (although needful of confirmation in the western-central sector of arctic Siberia), and attains practically the highest latitudes at which there is land, the northernmost known locality being 82° 30′ N. Lat. in Ellesmere Island (specimens seen in Herb. New York, Kew, and Copenhagen). Variable in the Arctic, as elsewhere.

CYSTOPTERIS MONTANA (Lam.) Bernh. (Mountain Bladder-fern) reaches the Arctic in southwestern Greenland (Polunin, 8; Porsild, 10) and the Alaska-Yukon sector (specimen seen in U. S. Nat. Herb.).

DRYOPTERIS AUSTRIACA (Jacq.) Woynar ex Schinz. & Thell. *s. l.* [incl. *D. spinulosa* (O. F. Müll.) Watt] (Spreading Shield-fern) occurs in southern Greenland, on both the east and west sides, and also just reaches the Arctic in the Alaska-Yukon sector (Hultén, 3).

DRYOPTERIS DISJUNCTA (Ledeb.) Morton (*D. linnaeana* C. Chr.) (Oak-fern) occurs in the Canadian Eastern Arctic (coll. Dr. J. Rousseau, 1948) and southern Greenland (on both the east and west sides), and so closely approaches our southern limit in Alaska-Yukon and parts of Eurasia that it would seem likely in time to prove far more widespread in the Arctic.

DRYOPTERIS FILIX-MAS (L.) Schott (Male Fern) likewise occurs in southern Greenland, on both the east and west sides, as has long been well known.

DRYOPTERIS FRAGRANS (L.) Schott (Fragrant Shield-fern) reaches the Arctic at least in the eastern-central and easternmost sectors of Siberia, in Alaska-Yukon, in western and eastern arctic Canada, and in West and East Greenland, thus ranging more than half-way around the top of the world. It has also been reported to reach the Arctic in western Siberia (Raymond, 11). It occurs as far north as 78° 52′ N. Lat. on Ellesmere Island (specimens seen in Herb. Gray, Kew, and Copenhagen), and probably a little farther north in Greenland (Ostenfeld, 4).

DRYOPTERIS PHEGOPTERIS (L.) C. Chr. (Beech-fern) occurs in southern Greenland, on both the east and west sides, and also reaches the Arctic in eastern Canada (Polunin, 7). Like several other widespread boreal Pteridophyta which are at present little known in the Arctic, it so frequently approaches our southern boundary that it would seem likely to turn up north of it in several more sectors such as Alaska-Yukon and parts of Eurasia when these come to be more thoroughly explored.

POLYSTICHUM LONCHITIS (L.) Roth (Holly-fern) occurs in southern Greenland, on both the east and west sides (specimens seen in the field, etc.).

WOODSIA ALPINA (Bolton) S. F. Gray (Alpine Woodsia) reaches the Arctic in Alaska-Yukon, in western and eastern Canada, and in West and East Greenland. Its northernmost known locality is near the 79th parallel on Ellesmere Island (specimen seen in Herb. Kew).

WOODSIA GLABELLA R. Br. apud Richardson (Smooth Woodsia) is probably circumpolar in distribution, having been recorded from almost all sectors of the Arctic, although not yet from around the eastern Europe-western Asia border or the adjacent (western-central) sector of Siberia. It ranges northward to about 79° N. on Ellesmere Island (specimens seen in Herb. Ottawa, Kew, and Copenhagen) and Spitsbergen, and reaches 79° 10′ N. Lat. in Greenland, where it was apparently the last plant noted [and collected (Ostenfeld, 4)] before his death by Dr. Thorild Wulff of whom the late Prof. C. H. Ostenfeld wrote (5), "The last words in his diary speak a stronger language of his deed than another is able to give; they run translated into English as follows: 'Straining walk until 29. Aug. 12,30 a.m. without finding any game. I am half-dead, but found *Woodsia*. Retired to rest at 7 p.m. as I will not be a hindrance to the movements of my companions on which their rescue depends.' In such a manful way my old friend from the days of youth ended his life, showing to the last that he was a real scientist.''

WOODSIA ILVENSIS (L.) R. Br. (Rusty Woodsia) reaches the Arctic in easternmost Siberia, in Alaska-Yukon, in western and eastern Canada, and in West and East Greenland.

EQUISETACEAE

EQUISETUM ARVENSE L. agg. (Common or Field Horsetail) is apparently circumpolar in distribution (though not yet confirmed from the easternmost sector of Asia), attaining almost the northernmost land (northernmost record 82° 29′ N. Lat. on the north coast of Greenland (cf. Ostenfeld, 5). Extremely variable, as elsewhere.

EQUISETUM FLUVIATILE L. (*E. limosum* L.) (Swamp Horsetail, or Pipes) has now been confirmed as reaching the Arctic in Alaska-Yukon (coll. Miss E. Scamman, 1949); it probably also persists north of our southern boundary in Eurasia, and has indeed already been widely reported to do so in the eastern-central sector of Siberia and in eastern Europe.

EQUISETUM PALUSTRE L. (Marsh Horsetail) reaches the Arctic in the northeastern European-northwestern Asian sector, in the western-central sector of Siberia, and in Alaska-Yukon (specimens seen in Herb. Stockholm).

EQUISETUM SCIRPOIDES Michx. (Dwarf Scouring-rush or Sedgelike Horsetail) is probably circumpolar in distribution but not yet confirmed from East Greenland. It attains a latitude of nearly 80° N. in Spitsbergen (Polunin 1933 field notes, specimens seen in Herb. British Museum; cf. Scholander [12]).

Equisetum sylvaticum L. agg. (Wood Horsetail) reaches the Arctic in eastern Canada (specimens seen in Herb. Gray and Ottawa), West Greenland (seen in the field), the northeastern European-northwestern Asian sector and probably elsewhere, being fully circumboreal and frequently approaching our southern boundary.

Equisetum trachyodon A. Br. (Rough-toothed Scouring-rush) occurs in one locality in southwestern Greenland (Polunin, 8).

Equisetum variegatum Schleich. (Variegated Horsetail or Northern Mottled Scouring-rush) appears to be fully circumpolar in distribution, ranging northwards to 82° 3′ N. Lat. in Greenland (Ostenfeld, 5).

LYCOPODIACEAE

Lycopodium alpinum L. (Alpine Club-moss) reaches the Arctic at least in the northeastern European-northwestern Asian sector, in the easternmost sector of Siberia, in Alaska-Yukon, in the Canadian Eastern Arctic, and in West and East Greenland.

Lycopodium annotinum L. agg. (Stiff Club-moss) reaches the Arctic at least in western-central and easternmost Siberia, in Alaska-Yukon, in western and eastern Canada, and in West and East Greenland.

Lycopodium clavatum L. (Common Club-moss, or Running-pine) reaches the Arctic in easternmost Siberia (Hultén, 3) and, as long well known, in West Greenland.

Lycopodium complanatum L. agg. (Trailing Christmas-green or Flattened Ground-pine) occurs in the Canadian Eastern Arctic (coll. Dr. J. Rousseau, 1948) and West Greenland and probably also East Greenland (Seidenfaden and Sørensen, 13).

Lycopodium selago L. (Fir Club-moss) is probably circumpolar in distribution, and the only high-arctic member of the genus, ranging northwards at least to about 81° 43′ N. Lat. in Ellesmere (Polunin, 7). However, it has not yet been recorded from the eastern-central sector of arctic Siberia.

SELAGINELLACEAE

SELAGINELLA RUPESTRIS (L.) Underw. (Rock Selaginella or Rock Spike-moss) has recently been found in one place in southwestern Greenland (Böcher, 1). The determination of a specimen from there sent by the collector to the present writer, was confirmed by the late Mr. C. A. Weatherby. In returning the writer's subsequent loan of the account by the collector (Dr. Tyge W. Böcher), Mr. Weatherby wrote (*in litt. ad* 29 May 1949) "The most reasonable theory (though, as Böcher warns, very much a theory) seems to me that such species as this largely Alleghenian *Selaginella* reached Greenland during . . . [a warm period] . . . and intermediate stations were wiped out by subsidence of the Atlantic shelf, ice-sheets, or the rigors of continental climate." It may be noted that this locality of *Selaginella rupestris* lies on the same fjord as, and not many miles from, the only known station of *Botrychium tenebrosum* (see above) in all Greenland, while nearby on an adjacent fjord grows *Equisetum trachyodon*. *Cystopteris montana* occurs around both these fjords, and it seems likely that further exploration will bring to light other unexpected treasures—particularly as an accompaniment of more overland foot-slogging (Polunin, 6).

SELAGINELLA SELAGINOIDES (L.) Link (Low Selaginella or Mountain moss) occurs in southern Greenland, on both the east and west sides as has long been known, and also reaches the Arctic at least in eastern Europe.

SELAGINELLA SIBIRICA (Milde) Hieron. (Siberian Selaginella or Siberian Spike-moss) reaches the Arctic in easternmost Asia and in Alaska-Yukon (specimens seen in Herb. Stockholm).

ISOËTACEAE

ISOËTES ECHINOSPORA Dur. *s.l.* (incl. *I. braunii* Dur.) (Spiny-spored Quillwort) is plentiful in southwestern Greenland and probably occurs also in East Greenland.

ISOËTES LACUSTRIS L. (Lake Quillwort) occurs in one place in southwestern Greenland [specimen seen in Herb. Copenhagen (Polunin, 8)].

It is to be expected that additions will be made to the above list of species of Pteridophyta known to occur in the Arctic—especially when some of the more favoured, southern regions come to be explored in greater detail. Meanwhile, it should be noted that in the above notes the Canadian Eastern Arctic is understood in the new, extended sense demanded by the criteria employed for delimitation. Among other Pteridophyta that require confirmation are reports of *Equisetum pratense* Ehrh. as persisting north of our southern boundary in some parts of Eurasia.

GRAY HERBARIUM OF HARVARD UNIVERSITY, CAMBRIDGE 38, MASS.

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POSTSCRIPT

Since the above was written I have happened upon the late Carl Christensen's paper "The Pteridophyta of arctic regions" published in the first volume of the American Fern Journal (No. 4, pp. 65–70, April 1911). Dr. Christensen lists 32 species of Pteridophyta as occurring in the Arctic. With the exception of *Botry-*

chium simplex (q.v. sub *B. boreale* and *B. tenebrosum*) and *Equisetum hiemale* (now known to be a misidentification for *E. trachyodon,* cf. Polunin, 8), these 32 are all identical with, or included in, the species given in my list. It is, however, interesting to note that *Cystopteris montana, Selaginella rupestris,* and the inadequately localized *Equisetum palustre* would not have qualified for inclusion in my list on the grounds given by Dr. Christensen (who had a wider conception of the Arctic), so that the additions since the time of his paper have been substantial in number as well as extensive in the matter of known ranges.

Dr. Christensen mentions (*op cit.,* p. 66) "*Gymnopteris triangularis* . . . a species of tropical relationship" as enumerated among plants collected near Nome City (which we would not include as arctic), but says "I do not remember whether the record is confirmed or not"; accordingly, he excludes it from his list, and indeed the report is now widely doubted; Hultén (3) remarks "It seems very uncertain that the species occurs in Alaska and a confirmation should be obtained before it is included in the flora. . . ."—N. P.

Dryopteris fragrans var. remotiuscula and Some Other Ferns from the Vicinity of Lake Sunapee, N. H.

A. R. HODGDON AND A. D. HASTINGS

During the late summer of 1949 an ecological and floristic study of the ferns of the areas bordering Lake Sunapee was conducted.[1] Two results of this work, at least, seem worthy of publication: the rediscovery of the station for *Dryopteris fragrans* (L.) Schott var. *remoti-*

[1] Research conducted in partial fulfillment of the requirements for the M.S. degree in Biology at the University of New Hampshire.

uscula Komarov, which was originally reported by C. E. Waters[2] and the recording of numerous additions to the fern floras of Sullivan and Merrimack Counties. Among these are two forms which would appear to be new to the state.

Waters (*loc. cit.*) writing of the Fragrant Fern supplies only the brief and inadequate geographical comment, "on a cliff by the shore of Lake Sunapee" which is quoted by Edith Scamman,[3] with her own additional comment, "probably in Sullivan County." September 11 was a red-letter day for the junior author when he rediscovered this station. On a shaded, east facing cliff on the western side of "The Narrows," four clumps were observed in nearly inaccessible niches of the rock-face. The peculiar features of this site leave little doubt that it is the same station reported by Waters. While this locality is very close to Sullivan County, to be entirely accurate, it must be reported as being at least one hundred and fifty yards within Merrimack County.

The following lists represent entities apparently new to Merrimack and Sullivan Counties as checked carefully against Miss Scamman's recent work.[4] Those with an asterisk are reported here from New Hampshire for the first time.

MERRIMACK COUNTY: *Asplenium Trichomanes* L.; *Athyrium Filix-femina* (L.) Roth var. *Michauxii* (Spreng.) Farwell forma *confertum* (Butters) Fern.; *Athyrium Filix-femina* var. *Michauxii* forma *cristatum* (Hopkins) Clute; *Athyrium Filix-femina* var. *Michauxii* forma *laciniatum* (Butters) Fern.*; *Botrychium dissectum* Spreng.; *Botrychium dissectum* forma *elongatum* (Gilbert & Haberer) Weath.*; *Botrychium dissectum*

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[2] Waters, C. E., *Ferns*, p. 214 and plate on p. 212. 1902.
[3] Scamman, Edith, *Ferns and Fern Allies of New Hampshire* Bulletin No. 2, N. H. Academy of Science, p. 32. 1947.
[4] Scamman, *op. cit.*

forma *oneidense* (Gilbert) Clute; *Dryopteris cristata* (L.) Gray var. *Clintoniana* (D. C. Eaton) Underw.; *D. fragans* (L.) Schott var. *remotiuscula* Komarov; *D. marginalis* (L.) Gray forma *elegans* (J. Robins.) F. W. Gray; *D. spinulosa* (O. F. Muell.) Watt var. *americana* (Fisch.) Fern; *D. spinulosa* var. *fructuosa* (Gilbert) Trudell; *Osmunda cinnamonea* L. forma *incisa* (J. W. Huntington) Gilbert; *Polypodium virginianum* L. forma *acuminatum* (Gilbert) Fern.; *Polystichum acrostichoides* (Michx.) Schott forma *incisum* (Gray) Gilbert.

SULLIVAN COUNTY: *Dryopteris simulata* (Davenp.) Underw.; *D. spinulosa* (O. F. Muell.) Watt var. *fructuosa* (Gilbert) Trudell; *Osmunda cinnamonea* L. forma *incisa* (J. W. Huntington) Gilbert.

Specimens of all of the above are in the herbarium of the University of New Hampshire.

DEPARTMENT OF BOTANY, UNIVERSITY OF NEW HAMPSHIRE, AND QM CLIMATIC RESEARCH LABORATORY, LAWRENCE, MASSACHUSETTS.

A New Jamaican Species of Hemitelia

C. V. MORTON AND GEORGE R. PROCTOR

During the first six months of 1950, the junior author made extensive collections of ferns in Jamaica, under the auspices of the Science Museum of the Institute of Jamaica. During the period of February 11–14, he made one of several collecting trips to the region of Corn Puss Gap. This mountain pass lies 2 miles due east of the better-known Cuna-Cuna Gap, and divides the eastern end of the Blue Mountains from the abrupt limestone escarpment of the John Crow Mountains, in the Parish of St. Thomas. The gap itself lies at an elevation of slightly over 2000 feet. A mule-track (wrongly shown on some maps as a road) passes through it, connecting the region of Bath in St. Thomas with that of Millbank in Portland. In the gap is also a hut belonging to the Jamaican Forestry Department; the use of this was generously allowed as a collecting base.

Corn Puss Gap is remarkable for its extremely high rainfall, which must approach 200 inches per year. A natural consequence is that the fern flora is very rich. No less than 9 species of tree-ferns were noted within a radius of 100 yards of the forestry hut, one of them the entity here newly described. The others include *Alsophila aspera* (L.) R. Br., *A Swartziana* Mart., *Cyathea arborea* (L.) J. E. Sm., *C. dissoluta* Baker, *C. Grevilleana* Mart., *C. Tussacii* Desv., *Hemitelia calolepis* D. C. Eaton, and *H. horrida* (L.) R. Br. Higher up, on the jagged limestone escarpment, occurs *Cyathea gracilis* Griseb. in some abundance. It may be noted that the soil in the gap itself is derived from shale. Probably other species still await discovery in this general area, which even yet is very little known botanically, especially eastward over the crest of the incredibly treacherous John Crow Mountains.

The proposed new species is dedicated to Mr. C. Bernard Lewis, for some years Curator of the Science Museum of the Institute of Jamaica, and recently nominated Director of the Institute. It was he who first pointed out the richness of the Corn Puss Gap flora to the junior author, and who chiefly made it possible for collections to be made there. The dedication is also intended as an expression of warm personal regard.

HEMITELIA **Lewisii** Morton & Proctor, sp. nov.

Species ex affinitate *H. calolepidis;* caudex arboreus, paleis subulatis perspice bicoloribus praeditus; frondes ovatae, breviter stipitatae, stipite inermi, muriculato, lamina bipinnato-pinnatifida, pinnis infimis brevioribus deflexis, petiolulatis, alteris subsessilibus, lanceolatis;

costae basi paleaceae, parce hirsutae, costulis parce villosis paleaceis, paleis bullatis, filiformi-attenuatis, brunnescentibus; sori inframediales, 8-vel 9-jugi, confluentes; paraphyses pauci; indusium subflabellatum vel semicirculare, breviter lobulatum.

Caudex stout, erect, reaching a height of 6 meters, densely paleaceous at the apex; scales basally attached, linear-subulate, erect, averaging 3 cm. in length, 1.8–3 mm. wide near the base, *bicolorous*, the whitish margin 0.5–0.9 mm. wide, minutely fimbriate by prolongation of the cells of the lamina, the castaneous or pale-castaneous central band extending to the long-attenuate tip (the cells of this band with lateral walls thickened and brown, the superficial walls pale yellow by transmitted light); stipes relatively short, 25–35 cm. in length, 1.5–1.8 cm. in thickness, stramineous, minutely muriculate, densely paleaceous above at the base, scales similar to those of the crown but broader (about 7 mm.), attached slightly above the base, with rounded basal auricles; lamina ovate, about 2.7 m. in length and 1.1 m. in width, bipinnate-pinnatifid, the rachis minutely muriculate, sparingly villous on the ventral (upper) surface; lowest pinnae reaching a length of 30 cm., deflexed, petiolulate, the petioles 4.5–5 cm. long; middle pinnae lanceolate, about 5.3 dm. long, 1.7–2 dm. broad, *subsessile* (petiolule 3 mm. long), abruptly acuminate; secondary rachis unarmed, glabrous and non-paleaceous below, densely hirsute above, trisulcate, non-paleaseous; secondary pinnae 25–30 pairs, lanceolate, sessile, 9–10 cm. long, 1.5–1.7 cm. broad, gradually attenuate to a subcaudate apex; costae sparingly hirsute below, and above toward the base, paleaceous at the base below, the scales whitish or *pale brownish*, subentire, bullate, about 1 mm. long and 0.4 mm. broad, with a setiform apex; segments about 30 pairs, narrowly oblong-falcate, 10 mm. long, 2.5 mm. broad, the margins crenate-lobulate and incurved, obtuse at the apex, all joined by a narrow wing 0.3–0.4 mm. broad; costules sparingly hirsute beneath, sparsely paleaceous with minute, *pale brownish*, bullate, hair-pointed scales, above mostly glabrous, except for a few, small, setiform hairs; veins 10–11 pairs, all but the uppermost once-forked below the middle; sori inframedial, 7–8 pairs, becoming more or less confluent with age; indusium extrorse, flabelliform to semicircular, irregularly and minutely lobed, not ciliate, brownish-hyaline, 0.5 mm. long; receptacle bearing a few paraphyses, these colorless, flaccid, several-celled, sharp-pointed, about 0.7 mm. long; sporangia apparently completely sterile, not producing spores.

TYPE in the U. S. National Herbarium, nos. 1,919,940–1, collected at Corn Puss Gap, Parish of St. Thomas, Jamaica, B. W. I., *Proctor* 4000, February 13, 1950. Isotypes at the Science Museum, Institute of Jamaica, the Academy of Natural Sciences of Philadelphia, and in the private herbarium of George R. Proctor.

Apparently related only to *Hemitelia calolepis* D. C. Eaton.[1] That species was described originally from Monte Verde, Oriente, Cuba (*Wright* 950) and several specimens of the type collection have been studied. Apparently the species has not been re-collected in Cuba, but a few specimens are known from Jamaica (without locality, *Wilson* 681, 738; Moody's Gap, *Underwood* 1550). Characteristic material was collected at Corn Puss Gap (*Proctor* 4001) at the same time that *H. Lewisii* was discovered; the two species were there growing side by side, and their distinctness was quite evident. The objective differences (that is, aside from subtle differences of aspect and coloration) can be summarized in the following key:

Pinnae stalked (petiolules 1–1.2 cm. long); rhizome scales white, bicolorous only at very base and slightly so near the apex; bullate scales of the costules abundant, white; stipe usually 50–70 cm long. *H. calolepis*

Pinnae subsessile (except the lower ones), the petiolules at most 3 mm. long; rhizome scales strongly bicolorous, the central, castaneous portion broad, the white margins narrow; bullate scales of the costules fewer, pale brownish; stipe not over 35 cm. long .... *H. Lewisii*

Washington, D. C.

[1] Cf. William R. Maxon, The North American Species of Hemitelia, Section Euhemitelia. Contr. U. S. Nat. Herb. **17**: 414–420. 1914.

The Correct Name of Phymatodes heterophyllum

ALEX D. HAWKES

Recently, while engaged in the preparation of a paper on the common plants of the Everglades National Park for the Florida Academy of Sciences, the question of the correct name of the Vine-Fern or Climbing Fern of South Florida appeared. This handsome, and often almost ubiquitous epiphytic species, has been known as *Phymatodes heterophyllum* (L.) Small, but by Copeland (1947) the genus *Phymatodes* is relegated to the synonymy of *Microsorium* Link.

Further inquiry and study have revealed that this fern is indeed a true *Microsorium*, and a new combination must be made to receive it:

Microsorium heterophyllum (L.) A. D. Hawkes, comb. nov.

Polypodium heterophyllum L. Sp. Pl. 1083. 1753.

Polypodium serpens Swartz, Prodr. Fl. Ind. Occ. 131. 1788 (non *P. serpens* Forst. 1786.)

Marginaria serpens Presl, Tent. Pterid. 188. 1836.

Polypodium exiguum Heward, Mag. Nat. Hist. ser. 2, **2**: 458. 1838.

Phlebodium serpens J. Sm. in Hook. Journ. Bot. **4**: 59. 1841.

Craspedaria serpens Fée, Gen. Fil. 264. 1852.

Anapeltis serpens J. Smith, Cat. Cult. Ferns 5. 1857.

Polypodium Swartzii Bak. in Hook. & Bak. Syn. Fil. 357. 1868.

Phymatodes Swartzii Underw. Our Nat. Ferns, ed. 6. 84. 1900.

Phymatodes exiguum Underw. Torreya **3**: 18. 1903.

Phymatodes heterophyllum Small, Ferns Fla. 81. 1932.

This species has been found in Collier, Dade, Monroe and Palm Beach Counties. Typically it is an epiphyte on smooth-barked trees in the hammock formations, the clambering rhizomes attaining a length of as much as 7 meters. The leaves are highly variable in dimension and shape.

DEPARTMENT OF BOTANY, UNIVERSITY OF CALIFORNIA, BERKELEY.

A Checklist of Kansas Pteridophytes

P. H. HUMFELD

A complete checklist of Kansas Pteridophytes has never been published. The first paper to include a list of Kansas ferns was that of Carruth (1872). He listed 9 species and followed this work with several publications during the next ten years bringing his list up to 22 species. This was followed by the work of Cragin (1885, 1886) in which the number known for Kansas was reduced to 20. Smyth (1890) reported a total of 38 species and varieties for the state. Later Smyth (1911) reported only 32 species and varieties for the region. Before and after the work of Smyth a few miscellaneous references were made to Kansas Pteridophytes but nothing of significance was accomplished until the publication of Gates (1940). In his work Gates was able to find specimens of 26 species. This was apparently the first accurate list compiled. Several of the earlier records were apparently based on plants in cultivation. In the herbarium at the University of Kansas are to be found several specimens of these early collectors. On the label of several sheets the word cultivated appears. After the publication by Gates we find that Horr and Mc-

Gregor (1946, 1947, 1948, 1949) and McGregor and Horr (1949) have added six species to the list as reported by Gates making a total of 32 species recorded before the present paper, in which 38 species are recorded.

In Kansas the number of habitats in which pteridophytes can be found are comparatively few in number. The eastern half of the state has a number of tree covered hills and valleys in which limestone and sandstone outcrops often occur. It is in these areas that most of the species are to be found. They are most abundant in the eastern three tiers of counties and in the southeastern quarter. The western half of the state has a few widely scattered localities for *Equisetum,* and *Marsilea vestita* is to be found in many lakes, ponds, roadside ditches, buffalo wallows and seepy areas.

During the past two years the author has made many field trips in the eastern half of the state, with the study of pteridophytes as his primary aim. As a result several species unreported for the state have been discovered and much distributional information on previously reported species was obtained. In addition he has been able to study material collected by R. L. McGregor, W. H. Horr, L. D. Volle, W. A. Hetzer, and R. H. Thompson, of the University of Kansas. Their specimens include many new distributional records and a few new records for the state.

In the following list the nomenclature adopted is that of Broun (1938), except for the Ophioglossaceae, which follows that of Clausen (1938). With each species listed is given the habitat in which the plant is commonly found. In addition the counties from which the species is known, based on herbarium specimens, is given along with the name of the collector and collection number.

Unless otherwise indicated all specimens are located in the herbarium at the University of Kansas. In several instances specimens reported by Gates (1940) have not been seen. Where these add to known distribution the county will be given followed by Gates (1940).

BOTRYCHIUM DISSECTUM Spreng. One collection known, *McGregor* 3870, collected in a creek valley thicket in Cherokee County.

BOTRYCHIUM DISSECTUM Spreng. var. obliquum (Muhl.) Clute. Rich woodlands. CHEROKEE: *McGregor* 3860. DOUGLAS: *McGregor* 726, 3888, 4079, *Humfeld* 150, 985, 1018. JEFFERSON: *McGregor* 4154. MIAMI: *Horr,* Oct. 10, 1943.

BOTRYCHIUM VIRGINIANUM (L.) Swartz. Rich woods and thickets. ANDERSON: *Horr,* July 23, 1929, *Humfeld* 292, *McGregor* 3211. ATCHISON: *Humfeld* 244, *McGregor* 2813. BOURBON: *Humfeld* 334, *McGregor* 3344. BROWN: *Humfeld* 255, *McGregor* 2836. CHAUTAUQUA: *Humfeld* 842. CHEROKEE: *Horr & McGregor* E488, *McGregor* 3003, *Humfeld* 63, 339, *Horr,* Apr. 2, 1942. COWLEY: *Horr & McGregor,* July 23, 1947. DONIPHAN: *Humfeld* 252, *McGregor* 2823. DOUGLAS: *McGregor* 550, *Walker* 3780, *Humfeld* 140, 147, 148, 179, 267, 300, 309, 984, 1013. FRANKLIN: *McGregor* 3050: GREENWOOD: *Humfeld* 801, *Horr,* June 28, 1930. JACKSON: *Humfeld* 259, 263, *McGregor* 2845, 2853. JEFFERSON: *McGregor* 880, *Horr* 3031, *Humfeld* 198, 200, 506. JOHNSON: *Coltrane,* May 24, 1832, *McGregor* 3062, *Humfeld* 595. LEAVENWORTH: *Horr,* May 9, 1939, *Humfeld* 195, 718, 1003. LINN: *Humfeld* 223. MARSHALL: *Volle* 790. MIAMI: *Horr,* May 17, 1947, *Humfeld* 157, 162, *McGregor* 2789. POTTOWATOMIE: *Humfeld* 391. SHAWNEE: *Humfeld* 767, 770, 771, *Volle* 53, 102, 148, 600, *Maus,* July 23, 1927 (Kansas State College, Hays). WOODSON: *McGregor* 905. WYANDOTTE: *Humfeld* 188. Gates (1940) reported specimens from Chase, Geary, Riley, Saline, Wabaunsee and Wilson counties.

OPHIOGLOSSUM ENGELMANNII Prantl. Calcareous soil. Pastures and open woodlands. ANDERSON: *Thompson,* June 19, 1949. ATCHISON: *McGregor* 887. CHEROKEE: *Horr & McGregor* 879, *Humfeld* 79. DOUGLAS: *McGregor* 9, 878, E484, *Horr,* Aug. 20, 1930, *Humfeld* 139, 146, 1011. JOHNSON: *Thompson,* Apr. 22, 1941, *Horr,* Aug. 12, 1933. LEAVENWORTH: *McGregor* 886. LINN: *Greene,* Sept. 9, 1920 (U. S. National Herbarium). MIAMI: *Humfeld* 156, 219. MONTGOMERY: *Humfeld* 107. WILSON: *McGregor,* June 30, 1947, *Humfeld* 123.

OPHIOGLOSSUM VULGATUM L. Gates (1940) reports a specimen from Douglas County in the herbarium at the University of Kansas. Such a specimen cannot now be found. However, a valid report is that of Clausen (1938) based on a collection from Crawford County by F. A. Riedel, June 15, 1929. Specimen in herbarium of the New York Botanical Garden.

OSMUNDA REGALIS L. One collection known, *Horr*, July 30, 1930. Wet creek bank in Woodson County.

ADIANTUM PEDATUM L. Rich woodlands. ALLEN: *McGregor* 968. ATCHISON: "S. A.," Aug. 23, 1932, *Humfeld* 245, *McGregor* 2814. BOURBON: *McGregor* 979. BROWN: *McGregor* 904. CHEROKEE: *McGregor* 983, 3357, *Humfeld* 337, 349, *Horr*, Apr. 2, 1942. COFFEY: *McGregor* 918. CRAWFORD: *McGregor* 981. DONIPHAN: *Horr*, July 11, 1947, *Humfeld* 253, *McGregor* 2822. DOUGLAS: *McGregor* 543, 3907, *L. A. Curry*, Nov. 6, 1915, *Humfeld* 151, 167, 576, 1016. FRANKLIN: *McGregor* 890. JACKSON: Gates (1940). JEFFERSON: *McGregor* 885. JOHNSON: *McGregor* 3434, *Humfeld* 611. LEAVENWORTH: *J. Wilson* 3706, *Humfeld* 186, 230, 234, 272, 721, 1002, *McGregor* 2792, 2799, 3079. LINN: *McGregor* 978, 3466. MIAMI: *McGregor* 896. NEOSHO: Gates (1940). OSAGE: *McGregor* 891. SHAWNEE: *Humfeld* 770, *Volle* 131. WILSON: Gates (1940). WOODSON: *McGregor* 917. WYANDOTTE: *McGregor* 2417, *Humfeld* 192, 1024.

ASPLENIUM PLATYNEURON (L.) Oakes. Sandstone and limestone rocks, sandy soil in woods and thickets. BOURBON: *McGregor* 974. CHAUTAUQUA: *McGregor* 941, 3374, *Humfeld* 96, 353, 806, 819, 822, 832, 854, 863. CHEROKEE: *McGregor* 1669, 982, 3776, *Horr*, Oct. 20, 1945, *Humfeld* 61. COFFEY: *McGregor* 909. CRAWFORD: *McGregor* 980. DOUGLAS: *McGregor* 660, *Humfeld* 30, 177, 298, 994, 995. ELK: *McGregor* 929. FRANKLIN: *McGregor* 899. GREENWOOD: *McGregor* 125, 933. JOHNSON: *McGregor* 898. LABETTE: *McGregor* 958. LEAVENWORTH: *Humfeld* 233, *McGregor* 2800. LINCOLN: *Humfeld* 960. MONTGOMERY: *McGregor* 945, 990, 3387, 3396, *Humfeld* 363, 371. NEOSHO: *McGregor* 956. WILSON: *McGregor* 935, *Humfeld* 112. WOODSON: *Humfeld* 3, 277, 282, 283, 978, 979, *McGregor* 3110, 3196, 3200.

ASPLENIUM PYCNOCARPON Spreng. LEAVENWORTH: *J. Wilson* 3729. WYANDOTTE: Gates (1940).

ASPLENIUM RESILIENS Kunze. Crevices shaded limestone and sandstone outcrops. BOURBON: *McGregor* 986. CHAUTAUQUA: *McGregor*, July 1, 1947, 954, *Humfeld* 860, 861. CHEROKEE: *McGregor* 985, 2553, 3359, *Humfeld* 76, 346. ELK: *McGregor* 938, *Horr* E416. GREENWOOD: *McGregor* 936. LABETTE: *McGregor* 969. MONTGOMERY: Horr, July 21, 1942. WILSON: *McGregor* 937. WOODSON: Gates (1940).

ASPLENIUM TRICHOMANES L. Crevices of sandstone outcrops. CHAUTAUQUA: *McGregor* 2416, 3378, *Humfeld* 95, 352, 803, 817, 834, 867. GREENWOOD: *Humfeld* 377, *McGregor* 3416, *Franklin & Horr*, June 10, 1939. WILSON: Gates (1940). WOODSON: *McGregor* 2413, 3197, *Horr, McGregor & Volle*, 3190, *Humfeld* 10, 286.

CAMPTOSORUS RHIZOPHYLLUS (L.) Link. On moist, shaded limestone and sandstone outcrops. ALLEN: *Humfeld* 328, *McGregor* 3336. ANDERSON: *Horr*, July 24, 1929, *McGregor* 3458. BOURBON: *McGregor* 1780, 989, 3343, *Humfeld* 332. CHAUTAUQUA: *Humfeld* 81, 843, 864, *McGregor* 3862. CHEROKEE: *McGregor* 988, 3361, 3755, *Humfeld* 62, 75, 347. COFFEY: *McGregor* 920. COWLEY: *Horr & McGregor*, July 23, 1947. CRAWFORD: Gates (1940). DOUGLAS: *McGregor* 29. ELK: *McGregor* 939. GREENWOOD: *Horr*, June 10, 1939. JOHNSON: *McGregor* 2346, 3432, *Humfeld* 33, 609. LABETTE: *McGregor* 959. LINN: *Humfeld* 38. MIAMI: *Horr*, Oct. 19, 1947, *Humfeld* 158, 221. MONTGOMERY: *McGregor* 2400, 3386, *Horr* E464, July 22, 1942, *Humfeld* 105, 367. NEOSHO: *McGregor* 960. RILEY: Gates (1940). WILSON: *McGregor* 2370, 993, *Humfeld* 111. WOODSON: *McGregor* 919. WYANDOTTE: Gates (1940).

CHEILANTHES ALABAMENSIS (Buckley) Kunze. One collection known, *McGregor* 3865, collected on dry exposed limestone outcrop in Cherokee County.

CHEILANTHES FEEI Moore. Sandstone rocks. ELLSWORTH: *McGregor* 1312. LINCOLN: Gates (1940). OTTAWA: *McGregor* 1315, *Humfeld* 417. WOODSON: Gates (1940).

CHEILANTHES TOMENTOSA Link. One collection known, *McGregor* 3866, collected on dry exposed limestone rocks in Cherokee county.

CHEILANTHES LANOSA (Michx.) D. C. Eaton. On sandstone and limestone outcrops. CHAUTAUQUA: *McGregor*, July 1, 1947, 943, 3377, *Humfeld* 97, 351, 802, 818, 831. CHEROKEE: *McGregor* 1668, *Humfeld* 60, 377. ELK: *McGregor* 926. MONTGOMERY: *McGregor* 946. WILSON: *McGregor* 924. WOODSON: *McGregor* 914, *Horr*, July 10, 1930.

CYSTOPTERIS FRAGILIS (L.) Bernh. var. PROTRUSA Weatherby. Rich moist woodlands. One collection of a forked specimen of the variety found in Jefferson Co., *Humfeld* 202. ANDERSON: *McGregor* 3458. ATCHISON: *McGregor* 881, 2817, *Humfeld* 246.

BROWN: *Humfeld* 256, *McGregor* 2837. CHAUTAUQUA: *Humfeld* 868. CLAY: Gates (1940). COWLEY: *Horr* 3152. DONIPHAN: *Agrelius, Hall, Lovejoy & Martin,* August 6, 1913, *Humfeld* 251, *McGregor* 2824. DOUGLAS: *McGregor* 86, *R. W. Hauk,* May 9, 1897, *A. Coltrane,* April 30, 1879, *Ella Coltrane,* May 9, 1887, *W. H. Herron* 3755, *Humfeld* 149, 165, 295, 383, 983, 1015. ELLSWORTH: *Humfeld* 437. FRANKLIN: *Hetzer* 44, *Humfeld* 173. GREENWOOD: *Humfeld* 378, *McGregor* 3419. JEFFERSON: *McGregor* 884, *Humfeld* 201. JOHNSON: *McGregor* 3431, *Humfeld* 606. LEAVENWORTH: *Humfeld* 183, 185a, 225, 232, 269, 725, 1004, *McGregor* 2798, 3077. LINN: *Humfeld* 41, *McGregor* 3465. MIAMI: *Humfeld* 154a, *McGregor* 2788. MONTGOMERY: *Horr,* July 5, 1930, *Z. D. Thompson,* July 2, 1937. OSAGE: Gates (1940). RILEY: W. A. KELLERMAN, May 29, 1886 (Kansas State College, Hays). SHAWNEE: *Humfeld* 766, 773, *Volle* 254. WILSON: Gates (1940). WYANDOTTE: *Humfeld* 189, 1026.

CYSTOPTERIS FRAGILIS (L.) Bernh. var. SIMULANS (Weatherby) McGregor. Crevices of limestone outcrops. ALLEN: *Humfeld* 325. BOURBON: *Humfeld* 333. CHAUTAUQUA: *McGregor* 944, *Humfeld* 359, 804, 833, 865. COWLEY: *Humfeld* 870. DOUGLAS: *Humfeld* 166, 181. ELLSWORTH: *Humfeld,* 430, 437. FRANKLIN: *Humfeld* 307. GREENWOOD: *McGregor* 3412. LEAVENWORTH: *Humfeld* 185. MIAMI: *Humfeld* 161, 213. MONTGOMERY: *McGregor* 950, 2399, 3392, *Humfeld* 368. WILSON: *McGregor* 925. WOODSON: *Horr,* July 10, 1930.

CYSTOPTERIS FRAGILIS (L.) Bernh. var. TENNESSEENSIS (Shaver) McGregor. In crevices of limestone and sandstone rocks, rarely on soil. ALLEN: *McGregor* 3333. ANDERSON: *McGregor* 3457. BOURBON: *McGregor* 3345. CHAUTAUQUA: *McGregor* 3384. CLAY: *Inis Avery,* Sept. 29, 1895. COWLEY: *Horr,* July 23, 1947. DOUGLAS: *McGregor* 3102. ELLSWORTH: *McGregor* 3302. FRANKLIN: *McGregor* 3310. JEFFERSON: *McGregor* 3452. JOHNSON: *McGregor* 3876. LEAVENWORTH: *McGregor* 1585. LINN: *McGregor* 3470. MIAMI: *Horr,* Oct. 19, 1947. MONTGOMERY: *McGregor* 3391. OSAGE: *McGregor* 3320. RICE: *McGregor* 2704. SALINE: *McGregor* 2688. SHAWNEE: *B. B. Smyth,* May, 1897. WILSON: *McGregor* 3404. WOODSON: *McGregor* 3192. WYANDOTTE: *McGregor* 2418, *Minnie Reed,* Oct. 3, 1889.

DRYOPTERIS GOLDIANA (Hook.) A. Gray. One collection is known, *J. Wilson* 3747, from Leavenworth County. Since Mr. Wilson has several cultivated specimens in the herbarium from this county and there is no other known collection of this species in the state the authenticity of this record is doubtful.

DRYOPTERIS MARGINALIS (L.) A. Gray. On sandstone outcrop and in sandy clay soil. CHAUTAUQUA: *McGregor* 940, 3376, *Humfeld* 94, 355, 810, 821, 828. CHEROKEE: *McGregor* 984. COFFEY: *McGregor* 908. ELK: *McGregor* 927. GREENWOOD: *Horr & Franklin,* June 10, 1939, *Horr,* June 10, 1939, *Humfeld* 124, 374, 379, *McGregor* 3411, 3417. LEAVENWORTH: *M. Johns,* July 2, 1929, *Humfeld* 224, *McGregor* 2791. MONTGOMERY: *McGregor* 947, 3394, *Horr* E456, *Humfeld* 360. SALINE: Gates (1940). WILSON: *McGregor* 923, *Humfeld* 127. WOODSON: *Horr,* July 30, 1930, July 30, 1939, *Humfeld* 1, 275, 279, 976, *McGregor* 3109, 3195.

DRYOPTERIS THELYPTERIS (L.) A. Gray. Marshes and seepy areas. CHAUTAUQUA: *McGregor* 942, 2414, *Humfeld* 829. DONIPHAN: Gates (1940). DOUGLAS: *McGregor* 707, 3306, 3882, *Humfeld* 301, 571, 989. ELK: *McGregor* 928. MONTGOMERY: *McGregor* 984, 3397, *Horr & McGregor* E423, *Humfeld* 361. POTTAWATOMIE, SALINE, and WASHINGTON: Gates (1940). WILSON: *McGregor* 921. WOODSON: *McGregor* 906.

NOTHOLAENA DEALBATA (Pursh) Kunze. On limestone outcrops. ALLEN: *Humfeld* 327, *McGregor* 3335. ANDERSON: *Humfeld* 129, 288, *McGregor* 3209. BOURBON: *McGregor* 972, 1779, 3342, *Humfeld* 335. CHAUTAUQUA: *McGregor* 951, *Humfeld* 84, 839, 847, 857. CHEROKEE: *McGregor* 971, *Humfeld* 80. COFFEY: *McGregor* 910. COWLEY: *Horr & McGregor,* July 23, 1947, *Rydberg & Imler* 532. CRAWFORD: *McGregor* 973. DOUGLAS: *McGregor* 874, *Humfeld* 136. ELK: *McGregor* 930. FRANKLIN: *McGregor* 911, 3309, *Humfeld* 308. GREENWOOD: *McGregor* 994, *Humfeld* 800. JEFFERSON: *Humfeld,* 132. JOHNSON: *Humfeld* 35, 603, *McGregor* 3435. LABETTE: *McGregor* 955. LEAVENWORTH: *Humfeld* 1019. LINCOLN: Gates (1940). LINN: *Humfeld* 39. LYON: Gates (1940). MIAMI: *Horr & McGregor,* Oct. 19, 1947, *Humfeld* 214. MONTGOMERY: *McGregor* 952, 2398, 3388, *Horr* E465, July 5, 1930, July 22, 1942, *Humfeld* 108, 366. NEOSHO: *McGregor* 957. POTTAWATOMIE: *Humfeld* 392, 396. RILEY: *D. E. Lantz,* May 22, 1886 (Kansas State College, Hays). SHAWNEE: Gates (1940). WILSON: *Humfeld* 113, 122. WOODSON: *McGregor* 907, 992.

ONOCLEA SENSIBILIS L. Seepy areas. CHAUTAUQUA: *McGregor* 2415, *Humfeld* 836. DONIPHAN: Gates (1940). DOUGLAS: *McGregor* 704, 3307, 3881, *Humfeld* 176, 302, 570, 988, 998, *L. A. Curry,* Sept. 20, 1915. JEFFERSON: *McGregor* 4152. JOHNSON:

Gates (1940). LEAVENWORTH: *J. Wilson* 3754, *Humfeld* 270, 1001. MONTGOMERY: *Horr & McGregor* E421. SALINE: *Humfeld* 448, 774. WOODSON: *McGregor* 2412, 3194, *Horr*, July 10, 1930, *Humfeld* 284.

ONOCLEA SENSIBILIS L. forma OBTUSILOBATA (Schkuhr) Gilbert. Seepy areas with the species. Only three known collections: DOUGLAS: *McGregor* 3884. MONTGOMERY: *McGregor* 2392. WOODSON: *McGregor* 2411.

PELLAEA ATROPURPUREA (L.) Link. On limestone outcrops. ALLEN: *McGregor* 963, 3332, *Humfeld* 322. ANDERSON: *Humfeld* 130, 290, *McGregor* 3209. ATCHISON: *Humfeld* 240, *McGregor* 2811. BOURBON: *McGregor* 975, 3341, *Z. D. Thompson* 639, *Humfeld* 329. CHAUTAUQUA: *Horr* E459, July 5, 1930, July 21, 1942, *Humfeld* 83, 840, 848, 855. CHEROKEE: *McGregor* 1672, 3360, 3362, *Humfeld* 59, 78, 342, *Horr & McGregor* 877. COFFEY: *McGregor* 913. COWLEY: *Horr & McGregor*, July 23, 1947. DOUGLAS: *McGregor* 137, 650. ELK: *McGregor* 931. ELLSWORTH: *McGregor* 2697, *McGregor & Horr* 3301, *Humfeld* 425, 429, 435, 949. FRANKLIN: *McGregor* 889. GREENWOOD: *McGregor* 934. JEFFERSON: *Humfeld* 133. JOHNSON: *McGregor* 2328, 3436, 3871, *Humfeld* 34, 604, *Thompson & McGregor* 876. LEAVENWORTH: *J. Wilson* 3695, *McGregor* 882, 2806, *Humfeld* 194, 236. LINCOLN: *Humfeld* 961, 965. LYON: Gates (1940). MCPHERSON: *Humfeld* 440. MIAMI: *Humfeld* 159, *Horr*, Oct. 19, 1947. MONTGOMERY: *McGregor* 991, 2397, 3389, *Humfeld* 106, 364. OSAGE: *McGregor* 875, 3317, *Humfeld* 314. OTTAWA: *Humfeld* 409, 414, 420. RICE: *McGregor* 2705. RILEY: Gates (1940). RUSSELL: *McGregor & Horr* 3293, *Humfeld* 953. SALINE: *McGregor* 2689, *Humfeld* 442. SHAWNEE: *Humfeld* 145. WILSON: *McGregor* 932, *Humfeld* 121. WOODSON: *McGregor* 915, *Horr*, July 5, 1930. WYANDOTTE: *McGregor*, July 27, 1947.

PELLAEA ATROPURPUREA (L.) Link forma CRISTATA (Trel.) Clute. On limestone outcrops with the species. ALLEN: *Humfeld* 323. ANDERSON: *Humfeld* 130a, *McGregor* 3207. ATCHISON: *Humfeld* 240. BOURBON: *Humfeld* 329a, *McGregor* 3348. CHAUTAUQUA: *Humfeld* 849. CHEROKEE: *Humfeld* 344. ELLSWORTH: *McGregor & Horr* 3299, *Humfeld* 436. JOHNSON: *Humfeld* 612. LEAVENWORTH: *Humfeld* 236a. LINCOLN: *Humfeld* 962. MCPHERSON: *Humfeld* 441. MIAMI: *Humfeld* 160, 209S, 210S. MONTGOMERY: *Humfeld* 365, *McGregor* 3391. OSAGE: *Humfeld* 315, *McGregor* 3318. OTTAWA: *Humfeld* 410, 415. SALINE: *Humfeld* 443.

(*To be continued*)

Shorter Note

IS ONOCLEA SENSIBILIS POISONOUS TO HORSES?[1]—Apparently, some work carried on and published a number of years ago by the New Hampshire Agricultural Experiment Station[2] is not at all familiar to students of ferns. Briefly, this research results in suspicion again being focused upon the common sensitive fern (*Onoclea sensibilis*) as a cause of serious horse poisoning.

Rich and Jones[3] many years ago concluded that ,in the region around Burlington, Vermont, all suspected cases of "polypod" poisoning (polypod being a local Vermont and New Hampshire name for the sensitive fern) were caused, in fact, by the common horsetail *Equisetum arvense*. This weed was always present in considerable quantity in all observed cases of poisoning. One infers from this article that in the actual feeding trials which they conducted, horsetail comprised nearly one-fourth by weight of the total hay fed to the horses. No experiments were carried on at that time using sensitive fern hay without the horsetail.

Observations made in 1941 and 1942 by certain veterinarians, particularly in the Connecticut Valley section of New Hampshire, and confirmed by staff members of the University of New Hampshire, directed attention again to the sensitive fern as a serious problem when present in large quantities in hay fed to horses. During those years, from several widely separated parts of New Hampshire, there came similar reports of horses sickening and dying after being fed on inferior weedy hay for extended periods during the winter months.

The common horsetail was immediately suspected but

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[1] New Hampshire Agricultural Experiment Station Scientific Contribution No. 132.

[2] Waller, E. F., Prince, F. S., Hodgdon, A. R., and Colovos, N. F. Sensitive-Fern Poisoning of Horses. N. H. Agr. Exp. Sta. Tech. Bull. 83, Dec. 1944.

[3] Rich, F. A., and Jones, L. R. A Poisonous Plant, the Common Horsetail (Equisteum arvense). Vermont Agr. Exp. Sta. Bull. 95, 1902.

diligent search brought to light remarkably little of it or none at all in some barns, whereas in all cases, without exception, the common sensitive fern was truly abundant, sometimes constituting as much as 20 per cent by weight of the hay.

In an attempt to resolve the matter, three horses as nearly of the same age and vigor as could be procured were obtained and stabled together at the University of New Hampshire. One was fed on grass-hay, the other two on fern-hay which by botanical analysis was found to contain between 15 and 20 per cent of sensitive fern. No fragments of horsetail were ever found in this hay despite several careful periods of search. If any were present, they must have been either in extremely small quantity or very highly localized in the hay. One of the two horses on the fern-hay diet became so sick after about six weeks that it had to be disposed of; the other became exceedingly nervous but eventually recovered. The third horse, as might be expected, suffered no ill effects from the grass-hay diet.

A precise account of the symptoms is given in the paper cited above which reports the results of the study. Several points should be noted: older horses are most susceptible; symptoms appear only after several weeks of more or less continuous feeding; and the fern in the fresh condition seems to cause no trouble. As a result of this study, it appears very likely indeed that horses will sicken or die if they are fed for long periods on hay which contains sensitive fern in quantity.

It is not the intention of this article to cast doubt on the poisonous character of the horsetail which has amply and repeatedly been demonstrated but to emphasize, in particular, our inadequate knowledge of the poisonous character of some of the true ferns.—A. R. HODGDON, *Department of Botany, University of New Hampshire, Durham, New Hampshire.*

American Fern Society

ANNUAL MEETING.—The annual meeting will be held this year in Minneapolis, Minnesota, in conjunction with the meetings of the Botanical Society of America, September 10–13. A field trip will be featured. Further details will be supplied later. Dr. Rolla M. Tryon, Jr., is chairman of the program committee. Members are urged to present papers at the meeting. The titles should be sent soon to Dr. Tryon at the Missouri Botanical Garden, St. Louis, Mo.

EASTERN FIELD TRIP.—Dr. R. C. Benedict will lead a field trip of the Fern Society jointly with the Torrey Botanical Club, starting at Springvale, New Jersey, September 29, Route 31, at 10:00 A.M. Dr. Svenson will be co-leader. Dr. Benedict reports that a visit to the Springdale Swamps on May 13 showed the fern flora to be flourishing, although one colony of hybrids was not found. The region is limestone country and provides a good array of the various species that like alkaline conditions.

FERN EXCHANGES INVITED.—Recently I received an invitation from Mr. Ryutaro Terashima, a member of the Japanese Diet, to meet him for a discussion. At the meeting, conducted through an interpreter, Mr. Raymond Conley, F.S.A., it developed that Mr. Terashima was speaking in behalf of Prof. Tomitaro Namegata, who is anxious to reestablish fern exchanges with collectors in the United States. I promised to report this interest to Fern Society members. Mr. Terashima seemed pleased and said that he would report the prospective cooperation of the Fern Society publicly before the Japanese Diet as an instance of international cooperation.

The ferns of Japan have perhaps a greater basis of interest for fern students of the United States than those of any other region. On the map, the islands of Japan stretch from a north latitude in the upper forties diagonally southwest to a latitude in the twenties. The range in latitude, the diagonal direction, and the range of climatic conditions match almost exactly the same features of the eastern coastal regions of the United States. Northern Hokkaido corresponds to position and climate to Maine; the southern Riu Kiu Islands match Florida.

The fern species show a similar range to those of our own eastern states, including some interesting duplications, the hart's tongue, for example. While some Japanese species are well known in cultivation with us, *Cyrtomium, Polystichum tsus-simense, et al.* the possibilities along horticultural lines are far from exhausted.

Professor Namegata, who is connected with the University of Tokyo, will welcome correspondence and opportunities for the exchange of herbarium material. He is an amateur in fern study and is trying to establish a Japanese Fern Society along the line of the American Fern Society. His home address is as follows: (as printed for me by Mr. Terashimo) : Mr. Tomitaro Namegata, Saiwito, Naritamichi, Imbagun Chibaken, Japan. —R. C. BENEDICT.

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American Fern Journal

Vol. 41 July–September, 1951 No. 3

The Pteridophyta of Mount Kenya

E. A. C. L. E. Schelpe

During the course of ecological survey studies on Mount Kenya (East Africa), carried out by members of the Oxford University Mount Kenya Expedition (1949), the author made an extensive collection of the pteridophytes inhabiting this mountain. Further specimens and data were provided by my colleague, Frank White.

Mount Kenya is the eroded relic of an ancient volcano and rises from the Kenya Highlands at 5,000 feet elevation to a snow-clad summit just over 17,000 feet high. Its southern and eastern slopes receive an annual rainfall of over 55 inches; the northern slopes have a rainfall of under 25 inches per annum, being in the rain shadow caused by the peaks themselves. The eastern and western slopes receive a rainfall intermediate between these two values. The rainfall is seasonal, the two rainy seasons being from February to June and from September to January.

Vegetation Types on Mount Kenya

The mountain is almost encircled by a crescent-shaped belt of forest. The interruption in this otherwise continuous belt occurs in the drier northern sector. On either side of this gap, the dominant forest tree is *Juniperus procera.* On the more moist western and northeastern slopes *Podocarpus milanjianus* assumes domi-

[Volume 41, No. 2, of the Journal, pp. 33–64, was issued June 26, 1951.]

nance, and on the wet south and southeastern slopes *Ocotea usambarensis* (East African "camphor") is an important constituent of the forest. Riverine forests extend along river-courses from the base of the mountain down to an altitude of 4,500 feet to the northeast of the massif. The montane forests are encountered at about 6,000 feet elevation and extend up to approximately an altitude of 8,000 feet. However, *Juniperus* forest may extend up to 9,900 feet in the northeastern sector. Above this forest belt, a dense zone of bamboo clothes the eastern, southern and western slopes up to an altitude of 9,000 to 10,000 feet. The upper limit of this bamboo is fringed by a zone of trees of *Hagenia abyssinica* and giant *Hypericum* (*Hypericum leucoptychodes*). In the dry northern sector, a wider zone of *Protea-Erica* scrub fringes the forest. Above these two zones, moorlands of tussock grass, inhabited by giant groundsels and giant Lobelias, grade into the alpine zone surrounding the peaks at about 15,000 feet altitude.

THE FOREST ZONE

RIVERINE FOREST

The climatic environment of the riverine forests to the northeast of Mount Kenya is generally dry, although on streambanks moister conditions occur. In the dry scrub marginal to these forests, *Adiantum hispidulum* was found to be locally common. In open but moister localities along riverbanks, *Pteris cretica* was found. The larger forest areas, such as that occurring along the Thuchi River, possessed a wider range of ferns which include *Asplenium Christii, A. gemmiferum, Cyrtomium caryotideum* var. *micropteris* and *Dryopteris elongata*. A small waterfall, 28 miles south of Meru, provided a continually wet habitat for *Asplenium unilaterale*, which was found rooting in soil aggregated about the thalli of hepatics. *Dryopteris gongylodes* frequently occurs in open streamside marshes.

JUNIPER FOREST

The dry *Juniper* forests appear to be generally poor in pteridophytes except about their upper margins where they extend into the gorges of rivers such as the Kathita River. In such gorges, the trunks of the forest trees are clad with mosses and lichens but the only epiphytic fern seen was *Polypodium lanceolatum.* However, a wide variety of ferns growing on fallen tree trunks and the humus overlaying boulders was found. These humicoles include:

Anogramma leptophylla (r.)[1]
Asplenium abyssinicum (f.)
aethiopicum (c.)
monanthes (o.)
sertularioides (c.)
Blechnum attenuatum (r.)
Cheilanthes farinosa (c.)
Cystopteris fragilis (o.)
Dryopteris africana (o.)
Elaphoglossum Deckenii (f.)
hybridum (f.)
hybridum (furcate form) (r.)
subcinnamomeum (c.)
Lycopodium clavatum (o.)
Saururus (r.)
Polypodium lanceolatum (c.)

The most interesting saxicolous fern collected in these gorges was *Hymenophyllum capillare,* which covered a comparatively dry vertical rock face. The fronds produced in more exposed parts of the rock face were considerably shorter. *Cheilanthes farinosa* was seen occasionally growing in moist rock crevices.

The shaded forest floors, which slope steeply from the cliff faces to the riverbed, are covered with a fairly dense ground layer vegetation in which ferns are prominent. The following species were collected in these habitats.

Adiantum Poiretii (o.)
Asplenium aethiopicum (c.)
sertularioides (c.)
Dryopteris elongata (o.)
Ophioglossum vulgatum (r.)
Polystichum setiferum (o.)
Pteris dentata (o.)
Selaginella Kraussiana (f.)

[1] The abbreviations used for species frequencies are: r.—rare, o.—occasional, l.f.—locally frequent, f.—frequent, c.—common, a.—abundant.

Selaginella Kraussiana was found to be far more abundant around the bases of scattered bamboo thickets in the bed of the gorge, a phenomenon possibly due to the paucity of ground layer vegetation below the bamboo and a consequent lack of competition. In the less sheltered habitats about the upper forest margin, *Lycopodium Saururus, L. clavatum,* and *Asplenium Adiantum-nigrum* were occasionally found.

PODOCARPUS FOREST

The fern flora of the *Podocarpus* forest on the southwestern sector and the *Podocarpus-Juniperus* forest on the western sector of the mountain is considerably poorer in quantity and variety of species than that of the more moist camphor forests on the southeastern sector. Epiphytic *Loxogramme lanceolata* was occasionally seen on streamside trees with *Trichomanes melanotrichum* growing among the rhizomes of the *Loxogramme.* A stunted form of *Polypodium lanceolatum* often grows on the more exposed branches of the *Podocarpus* trees. *Lycopodium dacrydioides* was found once growing epiphytically on *Ilex mitis* in the vicinity of Thiba Fish Camp.

Pteridophytes are rather infrequent on the forest floor and include *Asplenium lunulatum, A. anisophyllum* and *Pteris quadriaurita.* Occasionally large colonies of *Lonchitis glabra* may be encountered in more open areas in the transition belt between *Podocarpus* forest and the bamboo zone. The banks of streams running through open patches in the forest belt are occasionally populated with small colonies of the tree-fern *Cyathea Deckenii.*

CAMPHOR FOREST

The camphor forests occur in an area of high annual rainfall (over 55 inches) and provide a habitat for numerous pteridophytes. A striking feature of these forests is the relative abundance of epiphytic ferns, which include:

Asplenium aethiopicum (o.)	Loxogramme lanceolata (f.)
Mannii (c.)	Polypodium lanceolatum (f.)
Sandersonii (c.)	rotundum (f.)
theciferum (o.)	Trichomanes melanotrichum (l.f.)
Drynaria Volkensii (o.)	

Two forest trees, *Ocotea usambarensis* (camphor) and *Xymalos monospora*, appear to provide the most suitable substrate for these epiphytes. For example, the trunks of young *Xymalos* trees have a papery, cracked bark on which corticolous mosses could establish themselves fairly rapidly. Such locally moist substrates would favor the colonization and growth of epiphytic ferns. The two most common species, *Asplenium Mannii* and *A. Sandersonii*, are capable of rapid vegetative reproduction, the former by chlorophyllose stolons and the latter by proliferation at the apices of the fronds. *Trichomanes melanotrichum* was found to be locally frequent on the branches of young trees and lianes overhanging heavily shaded forest streams. In forest areas between streams, *Arthropteris monocarpa* is a frequent climbing epiphyte. Its rhizomes appeared to have grown up from the leaf litter on the forest floor and then ascended the trunk of the arboreal support. Some rhizomes had climbed up trees to a height of over five meters. In this species, and in specimens of *Loxogramme lanceolata*, individuals in lighter shade sporulated more freely than those in deeper shade.

Fallen trunks of forest trees in various stages of decay are frequently seen in these camphor forests and are inhabited by a number of humicoles. Some of the epiphytic ferns, such as *Asplenium Mannii, A. Sandersonii, Loxogramme lanceolata* and *Polypodium rotundum*, are apparently capable of tolerating the decrease in light intensity when a tree "host" falls and continue to grow on the humus of the decaying trunk. Other humicoles which grow on such logs are:

Asplenium anisophyllum (o.)	Oleandra distenta (l.f.)
Friesiorum (o.)	Vittaria Volkensii (o.)
Linckii (o.)	
Thunbergii (o.)	

The paucity of ferns in the ground layer of these camphor forests may be ascribed to the low light intensity on the forest floor. However, it seems more probable that the accumulating leaf litter in a seasonal rainfall area may afford an unsuitable substrate for the production of sporophytes since humicoles are frequent on decaying tree trunks lying on the forest floor in such areas. On rather bare forest floors, *Asplenium Linckii* is occasionally seen, and in areas with some angiospermic ground-layer vegetation, non-sporulating colonies of *Lycopodium clavatum* may be found. The banks of densely shaded forest streams may occasionally be inhabited by the short-trunked *Cyathea Stuhlmannii.*

Pteridium aquilinum colonizes large tracts beyond the lower margin of the forests and also invades cleared land in such areas. Trees left standing in the resultant dense bracken thickets may provide a support for epiphytic *Drynaria Volkensii* and *Asplenium aethiopicum.*

BAMBOO ZONE

The vegetation of the bamboo zone consists mainly of dense thickets of bamboo (*Arundinaria alpina*), which form a smooth canopy about thirty feet above the ground. The tops of large *Hagenia* and *Podocarpus* trees emerge more or less frequently through this canopy. The ground layer vegetation is subjected to deep shade and appears to be well-watered throughout the year. The most abundant pteridophyte in this zone is *Selaginella Kraussiana.* Ferns are common, especially on sloping ground and where the bamboo canopy is less dense, and include:

Asplenium anisophyllum (l.f.)
    lunulatum (o.)
    protensum (o.)
Dryopteris elongata (o.)
    foliosa (f.)
Elaphoglossum hybridum (o.)
    Aubertii (l.f.)
Histiopteris incisa (o.)
Pteris quadriaurita (o.)

The only locality where *Elaphoglossum Aubertii* was found was on the steep earth sides of an old elephant pit-trap in the dense shade of bamboos on the south-western sector of the mountain. Fries (1948) also records *Asplenium bipinnatum, Dryopteris Bergiana, D. kilemensis* and *D. silvatica* var. *completens* from the bamboo zone on the western sector of Mount Kenya.

Small patches of forest may occur along riverbanks among the bamboo. One of these small forest areas about the Lower Sagana Falls (9,000 feet alt.) was colonized by a fern population similar to that found in the upper *Juniper* forests in gorges on the northeastern sector of the mountain. Most of the terrestrial ferns were found on steep earthbanks at the side of the river. These included:

Asplenium abyssinicum (r.)
Athyrium scandicinum (o.)
    Schimperi (o.)
Cheilanthes farinosa (c.)
Dryopteris africana (o.)
Elaphoglossum Deckenii (o.)
    hybridum (o.)
Hymenophyllum capillare (l.f.)
Lycopodium clavatum (f.)

The epiphytes colonizing the trees were infrequent but some colonies of *Asplenium theciferum, Elaphoglossum Volkensii* and *Polypodium rigescens* were seen.

HYPERICUM ZONE

This vegetation belt fringing the lower moorlands takes its name from *Hypericum leucoptychodes,* a small tree forming a rather open tall scrub up to thirty feet high. Among this scrub, larger trees, such as *Hagenia* and *Podocarpus,* may occur.

Although the grayish lichen, *Usnea,* festoons the trees, only three epiphytic ferns were found in this vegetation belt. *Polypodium rigescens* is the most frequent, usually growing in moss-cushions, but a few colonies of *Polypodium rotundum* and *Asplenium aethiopicum* may be seen. Both the species of *Polypodium* may also occur as crevice plants on boulders scattered among the trees.

The quantity of terrestrial ferns occurring in the *Hypericum* zone varies widely in different sectors of the mountain. Few ferns occurred in the *Hypericum* zone on the western sector, but in the Sagana Valley on the southwestern sector, the following species were recorded.

Asplenium Uhligii (l.f.)
Athyrium Schimperi (l.f.)
Cystopteris fragilis (l.f.)
Cheilanthes farinosa (r.)
Dryopteris callolepis (r.)
Histiopteris incisa (o.)
Hypolepis rugulosa var. africana (a.)

Hypolepis rugulosa var. *africana* is the only fern among these that forms an important constituent of the ground-layer of this vegetation type. The six-feet-high fronds arise from widely creeping rhizomes that grow in humus a few inches below the leaf litter surface.

PROTEA SCRUB

In contrast to the wet *Hypericum* zone that borders the southern moorlands, a scrub composed of *Protea kilimandscharica* and ericoid shrubs covers the dry northern slopes up to the lower margin of the moorlands. The pteridophytes in this area appear to be confined to sheltered streambanks or to the more moist hollows in dense scrub thickets. The ubiquitous *Pteridium aquilinum* is a notable exception. It is more abundant and luxuriant in dense scrub. The confinement of other species to more moist habitats is probably due to their lower tolerance towards dry conditions and the low rainfall in this sector. The only pteridophytes found among this *Protea* scrub were:

Asplenium Adiantum-nigrum (r.)
aethiopicum var. (o.)
Lycopodium clavatum (l.f.)
Lycopodium Saururus (l.f.)
Polystichum setiferum (r.)
Pteridium aquilinum (c.)

MOORLAND

The moorlands of Mount Kenya comprise large tracts of tussock-grass studded with giant groundsels and giant Lobelias. *Lycopodium Saururus* is the only pteridophyte inhabiting the moorlands proper. It occurs in small colonies of tightly packed erect axes. Judging from the appearance of colonies on recently burnt moorlands, it seems that they are not damaged to any considerable extent by grass fires. This is probably due in part to their compact growth form. Rock outcrops are frequent in this moorland and are colonized by numerous mosses, but only two ferns. *Asplenium Uhligii* and *Polypodium rigescens* were found inhabiting some sheltered crevices on one of these outcrops at an altitude of 11,000 feet.

SIZE AND GROWTH FORM CHANGE WITH ALTITUDE

Moorland specimens of these ferns and lycopods tend to be smaller and more compact than specimens of such species growing at lower altitudes where they would be subjected to less exposure and less extreme climatic conditions. The maximum frond length (excluding stipe) of plants of *Asplenium Uhligii* growing on rock outcrops at 11,000 feet elevation was 6 cm., but in the *Hypericum* zone at 10,500 feet elevation fronds up to 12 cm. long were produced. Specimens of *Polypodium rigescens* growing as epiphytes in the bamboo zone produce fronds over 20 cm. long and have a subglabrous stipe. Individuals of this species growing on outcrops in moorland had a maximum frond length of 10 cm. and possessed a fibrillose stipe.

However, the most striking modification of growth form with increasing altitude is exhibited by *Lycopodium Saururus*. Individuals found on the forest margin at 9,800 feet elevation possessed lax stems up to 70 cm. long clothed in leaves 13 mm. long. At the upper altitude limit of this lycopod, i.e. 15,000 feet elevation, the erect stems, less than 12 cm. high, are closely compacted and arise at short intervals from rhizomatous lateral leafy axes. The stems are densely clothed with leaves only 7 mm. long. Specimens collected at various altitudes exhibit a gradation in axis and leaf length and in the compaction of the erect axes.

ACKNOWLEDGEMENTS

The author wishes to thank Mr. A. H. G. Alston of the British Museum (Nat. Hist.), London, for discussion and aid in the identification of the specimens.[2]

SUMMARY

The habitats of pteridophytes occurring on Mount Kenya (East Africa) are described and discussed. The frequencies of the various species found in various vegetation types are given. Change in the size and growth form in some of the species with increasing altitude is described.

WADHAM COLLEGE, OXFORD, ENGLAND.

REFERENCE

FRIES, R. E. & T. C. E. 1948. Phytogeographical researches on Mt. Kenya and Mt. Aberdare, British East Africa. K. Svenska Vetensk. Akad. Handl., *25*, 5.

[2] The botanical specimens collected by the Oxford University Mount Kenya Expedition, 1949, are housed in the Dept. of Botany, British Museum (Nat. Hist.), London.

A New Genus of Ferns

E. B. Copeland

Solenopteris Copeland, genus novum *Polypodiacearum*.

Filix egregia, rhizomate gracili late repente ramoso glauco, paleis parvis peltatis sparsis praedito, tuberifero; frondibus dimorphis ad rhizomate articulatis, sterilibus lanceolatis, pinnatifido-lobatis, herbaceis, glabris, venulis irregulariter anastomosantibus, venulis liberis inclusis raris; frondibus fertilibus duplo longioribus, linearibus; soris utroque latere costae uniserialibus, in areolis magnis ellipticis positis; paraphysibus filiformibus; annulo 12–14-articulato; sporis reniformibus, hyalinis.

Type and sole known species: *Solenopteris* **bifrons** (Hooker) Copeland, comb. nov. (*Polypodium bifrons* Hooker, Fil. Exot. *Pl. LII.* 1859.

The type of *B. bifrons* was collected by Jameson (no. 789), whose note on this collection reads: "On a tree by the river-side, near Archedoña, Ecuador (124 miles southeast of Quito, on an affluent of the Napo); it was partially immersed in the water, and from the roots were appended hollow, succulent tubers, in which ants had taken refuge." I have annotated fragments of this collection in the U. S. National Herbarium (no. 1,430,-026) as the type of the genus. Additional collections to be referred here are:

Colombia:

Putumayo: Umbría, 325 meters, in forest, December, 1930, *Klug* 1838. Climbing epiphyte in wet forest of Río Güamués, Quebrada del Achote, near San Antonio del Güamués, 310 meters, Dec. 19, 1940, *Cuatrecasas* 11209.

Ecuador:

Napo-Pastaza: Near Tena, in dense forest, 400 meters, Apr. 2–11, 1935, *Mexia* 7222.

Peru:

San Martín: Herb on tree, Pongo de Cainarachi, Río Cainarachi (tributary of Río Huallaga), 230 meters, September–October, 1932, *Klug* 2643.

Hooker called this "a very peculiar species of *Polypodium* (sect. *Drynaria*, Fée, but probably a *Microgramma* of Presl)." It does have more resemblance to *Microgramma* than to anything else, and this may be its affinity, but the rather fleshy, herbaceous texture, and the laxly and irregularly anastomosing veins, and the paucity of included veinlets make it seem unreasonable to include it in that genus. The tubers are remarkable; but I would not regard them as by themselves justifying generic distinction for the species, no more than do those of *Nephrolepis cordifolia.*

UNIVERSITY OF CALIFORNIA, BERKELEY.

An Overlooked North American Fern

A. H. G. ALSTON

Cystopteris Baenitzii was described by Doerfler in 1890, based on specimens from two widely separated localities—Kongsfold, Dovre Fjeld, Norway, and San Bernardino, California. Since that time it has been recorded and studied from several localities in Scandinavia: Norway (Nordstedt, 1891, and Blytt, 1892), Sweden (Rosendahl, 1910, Samuelsson, 1921), Finland, Karelia, and Spitzbergen (Lindberg, 1905). Later it was decided that *C. Baenitzii* is a synonym of *C. Dickieana* Sim, of Scotland, which, although extremely rare as a wild plant, has long been cultivated in England and has been recognized by fern growers as a distinct entity.

The principal difference between *C. Dickieana* and *C. fragilis* is in the spores, those of the former being rugose and those of the latter echinate. The rugose-verrucose spores of some specimens referred to *C. fragilis* had been noted by Milde (1867, pp. 148, 150, 151), who recorded specimens from Blidah and Tiaret, in Algeria, from western Tmolus, near Smyrna, in Turkey (*Ba-*

lansa), and from the Sierra de las Nieves, near Ronda, Spain (*Bourgeau* 511). Milde also recorded verrucose spores in *C. Dickieana,* which he regarded as a variety of *C. fragilis,* and in *C. atrovirens* Presl (1851), which was described from a plant cultivated in the Berlin Botanical Garden. Komarov (1934, p. 25) recorded *C. Dickieana* from Anadyr, in arctic Siberia, Ob, in western Siberia, Lena-Kolyma, Yenisei, and Angara-Sayan, in eastern Siberia. Professor Manton (1950, p. 120) added Persia to the list; her record is based on specimens from Kuh-i-Jupar, 28 miles south of Kirman, 3400 meters, *Bornmueller* 4487, which is the type collection of var. *kermanensis* B. Fedtsch (1946).

Since the original description of *C. Baenitzii,* I can not find that the species has been mentioned in any work on the flora of North America, except by Macoun and Burgess (1884, p. 213), whose specimen was misidentified. An examination of the material at the British Museum (Natural History) has provided many records from the Himalayas and from Greenland, and also the following from continental North America:

ALASKA: Lake Iliamna region, *Gorman.*

BRITISH COLUMBIA: Selkirk Mountains, 7500 feet, *Hacock* 285, *C. H. Shaw* 285. In crevices of calcareous shale on Mount Stephen, 4500 feet, Yoho Park, *Ulke* F15.

ALBERTA: Snowline, 5200 feet, above railway station, Chateau Lake Louise, *Enander.*

WASHINGTON: Near Egbert Spring, Douglas County, 2000 feet, *Sandberg & Leiberg* 351.

IDAHO: Limestone cliff, Mystic Lake, 6000 feet, *Blankinship* 637. Valley of Peter Creek, Nez Perces County, *Sandberg, Macdougall & Heller* 119. On moist rock outcrops along stream opposite Kamiah, Idaho County, *Meyer* 921.

CALIFORNIA: San Bernardino (syntype, ex Doerfler). New York Falls, 2000 feet, Amador County, *Hansen* 646. Susanville, Perkin's Ranch, 4800 feet, *M. E. Jones.* Davis Creek, *Mrs. R. M. Austin.*

Fée described a *Cystopteris acuta* from Mexico (*Gale-*

otti 6260, from Orizaba, Veracruz) as having "sporis ovoideis": it may be the same species. There are specimens of *C. Dickieana* in the British Museum from Mexico "Km. 61, road from Mexico City to Cuernavaca, 4600 meters, *Mexía* 2722." In addition, there are some South American specimens with rugose spores, from Colombia (Santa Marta, *Purdie*), and Bolivia (Yumani, *Asplund* 2617; Incachacua, *Asplund* 3446).

BRITISH MUSEUM (NATURAL HISTORY),
LONDON, ENGLAND

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A Checklist of Kansas Pteridophytes

P. H. HUMFELD

(*Continued from page 60*)

PELLAEA GLABELLA Mett. ex Kuhn. Calcareous rocks. ALLEN: *Humfeld* 324, *McGregor* 3331. BOURBON: *McGregor* 1781, 3340, *Humfeld* 330. CHAUTAUQUA: *Humfeld* 82, 846. CLAY and CLOUD: Gates (1940). COWLEY: *Horr & McGregor*, July 23, 1947, *Humfeld* 869. DOUGLAS: *McGregor* 180, 649. ELLSWORTH: *McGregor* 1311. FRANKLIN: *McGregor* 892. GEARY: *Humfeld* 967. GREENWOOD: *Humfeld* 799. JOHNSON: *McGregor* 893, 3433. KIOWA: Gates (1940). LABETTE: Gates (1940). LEAVENWORTH: *Humfeld* 187. LINCOLN: Gates (1940). LINN: *Humfeld* 40. MONTGOMERY: *Horr* E463, July 22, 1942, *Humfeld* 369, *McGregor* 3390. OTTAWA: *McGregor* 1314, *Humfeld* 416. POTTAWATOMIE: *Humfeld* 395. RICE: *McGregor* 2706. RILEY, SALINE, SHAWNEE and WABAUNSEE: Gates (1940). WILSON: *Humfeld* 120. WOODSON: *Horr*, July 10, 1930.

PHEGOPTERIS HEXAGONOPTERA (Michx.) Fée. Only one station known for this fern, in Cherokee County, in well drained calcareous soil in deciduous woods, *McGregor* 970, E517, 3355, 3843, *Humfeld* 336.

POLYSTICHUM ACROSTICHOIDES (Michx.) Schott. In well drained calcareous and sandy clay soils. CHAUTAUQUA: *Humfeld* 356, 809, *McGregor* 3373. CHEROKEE: *McGregor* 987, 3356, 3844, 3861, *Horr & McGregor* E489, *Horr*, Oct. 20, 1945, *Humfeld* 58, 338. GREENWOOD: *Horr*, June 10, 1939. MONTGOMERY: *McGregor* 949. WILSON: *McGregor* 922. WOODSON: *McGregor* 916.

POLYSTICHUM ACROSTICHOIDES (Michx.) Schott f. INCISUM (Gray) Gilbert. Only one collection, *McGregor* 1670, from Cherokee County, in well drained calcareous soil, in woodland with the typical form.

POLYPODIUM POLYPODIOIDES (L.) Hitchcock. Only one station known, in Chautauqua County, in a wooded sandstone area on a large boulder, *McGregor* 3379, *Humfeld* 357, 808.

PTERIDIUM LATIUSCULUM (Desv.) Hieron. ex R. E. Fries var. PSEUDOCAUDATUM (Clute) Maxon. Only one collection known, *McGregor* 3863, on top of dry rocky wooded hill in Cherokee County.

WOODSIA OBTUSA (Spreng.) Torr. Woods, thickets, rock outcrops, and sandy banks in prairie. ALLEN: *McGregor* 953, 3334, *Humfeld* 326. ANDERSON: *Horr*, July 23, 1929, *Humfeld* 291, *McGregor* 3207. ATCHISON: Gates (1940). BOURBON: *McGregor*

977, 3339, *Humfeld* 331. CHAUTAUQUA: *Humfeld* 358, 811, 827, 844, 859, 862, 866, *McGregor* 3375. CHEROKEE: *Humfeld* 345, *McGregor* 3358. CLAY, CLOUD and COFFEY: Gates (1940). COWLEY: *Horr & McGregor*, July 23, 1947. CRAWFORD: *McGregor* 976, 1750. DONIPHAN: Gates (1940). DOUGLAS: *McGregor* 106, *L. A. Curry*, Oct. 2, 1915, *Humfeld* 32, 168, 178, 182, 293, 294, 299, 572, 577, 982, 990a, 996, 1014. ELK: *McGregor* 965. ELLSWORTH: *McGregor & Horr* 3297, *Humfeld* 424, 431, 434, 947. FRANKLIN: *Hetzer* 38, *McGregor* 894, 3311, *Humfeld* 172, 306. GREENWOOD: *McGregor* 964, 3413, *Humfeld* 376. JEFFERSON: *McGregor* 883. JOHNSON: *McGregor* 897. LABETTE: Gates (1940), *Rydberg & Imler* 338. LEAVENWORTH: *J. Wilson* 3763, *Humfeld* 184, 227, 229, 235, 1005, 1020, *McGregor* 2794. LINCOLN: *Humfeld* 423, 963, 966. LINN and LYON: Gates (1940). MARSHALL: *McGregor* 902. MCPHERSON: *Humfeld* 439. MIAMI: *Horr*, Oct. 19, 1947, *McGregor*, 895, *Humfeld* 222. MONTGOMERY: *McGregor* 2401, 3369, 3385, 3395, *Z. D. Thompson* 638, *Horr* E466, July 24, 1942, *Humfeld* 350, 362, 370. MORRIS: Gates (1940). NEMAHA: *McGregor* 903. NEOSHO: *McGregor* 961. OSAGE: *McGregor* 888, 3319, 3315, *Humfeld* 313, 316. OTTAWA: *Humfeld* 411, 419, 421, 887. POTTAWATOMIE: *Humfeld* 393, 403. RILEY: *Humfeld* 406. RUSSELL: *McGregor & Horr* 3291, *Humfeld* 954. SALINE: *Humfeld* 408, 427, 444. SHAWNEE and STAFFORD: Gates (1940). WASHINGTON: *McGregor* 901. WILSON: *McGregor* 962, 3401, *Humfeld* 372. WOODSON: *Horr*, July 10, 1930, *Humfeld* 274, 287, 977, *McGregor* 3108, 3178, 3196a. WYANDOTTE: *Humfeld* 193, 1023.

EQUISETUM ARVENSE L. Sandy clay ditches and stream banks. ATCHISON: *Humfeld* 242, 583, *McGregor* 2807. BROWN, CLAY and CLOUD: Gates (1940). DONIPHAN: *Horr*, July 11, 1947, *Humfeld* 248, 254, *McGregor* 2819, 2820, 2825. DOUGLAS: *F. H. Snow* 3649. *McGregor* 662, 3304, *Humfeld* 31, 174, 304, 573, 986, 992, 997, 1017. JACKSON: *Humfeld* 260, *McGregor* 2844. JOHNSON: *McGregor* 3430. LEAVENWORTH: *Humfeld* 197, 238, 271, 1006, *McGregor* 2803, 3074. POTTAWATOMIE: *Humfeld* 400, 401, 969. RILEY: Gates (1940). ROOKS: *Elam Bartholomew* 1472 (Kansas State College, Hays). WYANDOTTE: *Humfeld* 190, 1021.

EQUISETUM ARVENSE L. spp. RAMULOSUM (Rupr.) Rapp. Sandy clay ditches and stream banks with the typical subspecies. ATCHISON: *Humfeld* 243, *McGregor* 2808. DONIPHAN: *Humfeld* 249. DOUGLAS: *Humfeld* 175, 305, 574, 987, 993, *McGregor* 3305. JEFFERSON: *McGregor* 4153. LEAVENWORTH: *Humfeld* 198, 239, 1006, 1022, *McGregor* 2804. POTTAWATOMIE: *Humfeld* 970.

EQUISETUM KANSANUM Schaffner. Sandy clay roadsides, meadows, sometimes railroad right of ways. BARTON: *McGregor* 3944. CLARK: *McGregor* 4025. CHASE, CHAUTAUQUA, CHEYENNE and DECATUR: Gates (1940). DONIPHAN: *Humfeld* 247, *McGregor* 2818. DOUGLAS: *McGregor* 718, 2435, 3329, *Humfeld* 319. EDWARDS: Gates (1940). ELLIS: *F. W. Albertson* 80 (Kansas State College, Hays). ELLSWORTH: *McGregor* 2695, *Humfeld* 428, 438. FINNEY: *McGregor* 4000. GOVE, GRAY, and HAMILTON: Gates (1940). HARVEY: *McGregor & Yokoyama* 3496. JEFFERSON: *Humfeld* 386. KINGMAN: *McGregor & Horr* 3043, 3229. MARION: *Humfeld* 790, 791. MEADE: *McGregor* 4016. MITCHELL and NESS: Gates (1940). OTTAWA: *Humfeld* 413. POTTAWATOMIE: *Humfeld* 389, 390, 399. RENO: *McGregor* 3941. RICE: *McGregor* 2703, 3942. RILEY and ROOKS: Gates (1940). SALINE: *McGregor* 2687, *Humfeld* 426. SCOTT: Gates (1940). SHAWNEE: *Schaffner*, July 12, 1935 (Kansas State College, Hays). SHERIDAN, STAFFORD, TREGO, WALLACE, and WABAUNSEE: Gates (1940).

EQUISETUM KANSANUM Schaffn. f. VARIEGATOIDES (A. A. Eaton) Broun. Wet sandy banks. DOUGLAS: *McGregor* 3330, *Humfeld* 320. PRATT: *McGregor* 2215.

EQUISETUM LAEVIGATUM A. Br. Railroad right of ways, stream banks and meadows. ATCHISON: "*S. A.*," May 29, 1932, *Humfeld* 241, *McGregor* 2809, *Horr & McGregor* E409. BARBER and CHEYENNE: Gates (1940). CLAY: *McGregor* 2076. CLOUD: Gates (1940). COWLEY: *Horr* 3148. DECATUR: Gates (1940). DOUGLAS: *Humfeld* 265, *McGregor* 3027. ELLIS: Gates (1940). ELLSWORTH: *Humfeld* 934, 948. FRANKLIN: *Hetzer* 432. GEARY: *R. H. Imler*, June 3, 1929. GRAHAM: Gates (1940). HARVEY: *Doell* 183. KINGMAN: *McGregor* 2231. JEFFERSON: *Humfeld* 264, 385, *McGregor* 2854. LEAVENWORTH: *Humfeld* 237, *McGregor* 2805. LINCOLN: *Humfeld* 956, 957. MEADE and MORRIS: Gates (1940). OTTAWA: *McGregor* 1455, *Humfeld* 412. POTTAWATOMIE: *Humfeld* 972. RAWLINS and RENO: Gates (1940). RILEY: *R. H. Imler*, June 3, 1929. SHAWNEE: *Humfeld* 388. SHERIDAN and WASHINGTON: Gates (1940). WICHITA: *Agrelius & Agrelius*, Aug. 22, 1912. WOODSON: *Horr*, July 10, 1930.

EQUISETUM PREALTUM Raf. Roadside swales, seepage areas. ALLEN: Gates (1940). ATCHISON: "*S. A.*," May 29, 1932, *McGregor* 2733, *Humfeld* 582. BROWN: *Horr*, July 10, 1947. CHEROKEE: *Humfeld* 77, 348, *McGregor* 2734, 3365. CLAY: Gates (1940). DONIPHAN: *Agrelius, Hall, Lovejoy, & Meroney*, Aug. 6, 1913, Aug. 8, 1913, *Humfeld* 250, *McGregor* 2821. DOUGLAS: *L. A. Curry*, Oct. 2, 1915, *F. H. Snow* 3657, *McGregor* 653, 3303, *Hum-*

feld 21, 153, 303, 384, 575, 981, 990, 1009. EDWARDS: Gates (1940). JACKSON: *Humfeld* 257, 258, *McGregor* 2843, 2839. JEFFERSON: *Humfeld* 138, 542. JOHNSON: *McGregor* 3429. LEAVENWORTH: *Humfeld* 196, 228, 273, 1000, *McGregor* 2793, 3075. LINN: *McGregor* 3467. LYON and OSAGE: Gates (1940). POTTAWATOMIE: *Humfeld* 402, 971. REPUBLIC: Gates (1940). RILEY: *Gates & Newcomb* 15,111. ROOKS: *Elam Bartholomew*, June 25, 1890 (Kansas State College, Hays). SALINE: *Humfeld* 446, 447, 780, 787. SCOTT: Gates (1940). SHAWNEE: *Humfeld* 387, 973. SUMNER, TREGO, and WILSON: Gates (1940). WOODSON: *Humfeld* 280, *McGregor* 3193. WYANDOTTE: *Humfeld* 191, 1025.

SELAGINELLA RUPESTRIS (L.) Spring. Shallow sandy clay soil on sandstone outcrops. CHAUTAUQUA: *McGregor* 997, *Humfeld* 93, 354, 812, 823, 835, *Horr*, June 3, 1939. DOUGLAS: *Thompson*, May, 1932, *McGregor* 1001, 3901, *Humfeld* 169, 297, 578, 1030. ELK: *McGregor* 966. FRANKLIN: *McGregor* 1003. GREENWOOD: *McGregor* 998, 3410, *Humfeld* 126, 373. JOHNSON: *McGregor* 1004. LEAVENWORTH: *McGregor* 999. MONTGOMERY: *McGregor* 996. NEOSHO: *McGregor* 967. WILSON: *McGregor* 995, *Humfeld* 128. WOODSON: *McGregor* 1002, 3198, *Humfeld* 2, 19, 276, 281.

MARSILEA VESTITA Hook. and Grev. In lakes, ponds, roadside ditches, buffalo wallows and seepy areas. BARTON: *McGregor* 3945. BUTLER: *Humfeld* 798. CHASE: *McGregor* 3937. CLARK: *McGregor* 4024. CLOUD, COFFEY, EDWARDS: Gates (1940). ELLIS: *McGregor & Horr* 3286, *F. W. Albertson* 691 (Kansas State College, Hays). FINNEY: *McGregor & Horr* 3276, *McGregor* 3991. FORD: *McGregor* 3972. GOVE and GRAHAM: Gates (1940). GRAY: *McGregor & Horr* 3270. HARVEY: *Doell* 22, *McGregor & Thompson* 3493, *McGregor* 3503, 3504, *Humfeld* 900, 910. HASKELL: *McGregor* 4001. HODGEMAN: *McGregor* 3962. KINGMAN: *McGregor* 2230. KIOWA: *McGregor* 4043. LANE: *McGregor & Horr* 3278. MEADE: *McGregor & Horr* 3256. NESS: Gates (1940). PAWNEE: *McGregor* 3951. POTTAWATOMIE: Gates (1940). PRATT: *McGregor* 4045. RENO: *McGregor* 3943. ROOKS and RUSH: Gates (1940). SALINE: *Humfeld* 445, 871. SCOTT: Gates (1940). SEDGWICK: *McGregor* 4047. SEWARD: *McGregor* 4010. WALLACE: Gates (1940). WASHINGTON: *McGregor* 1000.

PILULARIA AMERICANA A. Br. One collection known, *McGregor* 3933, from Reno County, on the border of small pond in the sand-dune area.

AZOLLA CAROLINIANA Willd. Permanent ponds and ox-bow lakes visited by migratory birds. DOUGLAS: *Thompson*, Oct. 8, 1949, *Volle* 1005, *McGregor* 4140, 4142, *Humfeld* 1008, 1012, 1027, 1029. JEFFERSON: *McGregor* 4166.

ISOËTES BUTLERI Engelm. Reported by Gates (1940) from Cherokee County.

ISOËTES MELANOPODA Gay and Durieu. One collection known, *John Hancin* 2447, from Saline County, in a low spot in a wheat field that had not been plowed until recently.

The author is grateful to R. L. McGregor, of the Department of Botany, University of Kansas, for suggesting the problem and for invaluable assistance in carrying out the work, and to W. H. Horr of the same institution for helpful guidance in the course of this problem.

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HUTCHINSON, KANSAS

A Fern New to the United States

C. V. MORTON

Mrs. Mary W. Diddell, of Jacksonville, Florida, recently sent a fern to me for identification which has proved to be *Dryopteris sclerophylla* (Kunze) C. Chr. The specimen was collected originally by Mr. Fred Fuchs in a hammock near Florida City, Dade County, Florida and presented by him to Mrs. Diddell. This fern is common in Cuba and occurs in varietal forms in Jamaica, Hispaniola, and Puerto Rico also. The Florida fern seems to be identical with Cuban material. This species has not been reported from the United States, but I find on looking in the U. S. National Herbarium that it has been collected once before. There is a specimen received from the Florida Botanical Garden and Arboretum collected in the Sykes Hammock, near Silver Palm, Dade County, on July 1, 1940, by J. B. McFarlin. The specimen was identified by Dr. William R. Maxon as *Dryopteris sclerophylla,* and marked by him as "new to the United States."

Dryopteris sclerophylla belongs to the section *Goniopteris.* Therefore the only related species in the United States are *D. reptans* and *D. subtetragona.* It is a rather strange aberration of J. K. Small that he should place *D. reptans* in the genus *Goniopteris* and *D. tetragona* (i.e. *subtetragona*) in *Thelypteris.* These two species surely belong in the same genus, whatever name may be applied. At the present time I believe that *Goniopteris* should be included in *Thelypteris,* as a section, distinguished from typical *Thelypteris* by the presence of stellate hairs on the rhizome scales and often also on the rhachis, costae, or leaf surfaces. The following transfers are required:

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THELYPTERIS **sclerophylla** (Kunze) Morton, comb. nov.
Aspidium sclerophyllum Kunze[1] in Spreng. Syst. Veg. **4**: 99. 1827; Linnaea **9**: 92. 1834.

THELYPTERIS **reptans** (J. F. Gmel.) Morton, comb. nov.
Polypodium reptans J. F. Gmel. Syst. Nat. **2**: 1309. 1791.

These three species may be distinguished as follows:

Blades essentially imparipinnate, the terminal pinna conform with the lateral .... T. tetragona[2]
Blades regularly pinnatifid toward apex.
Hairs of costae, leaf surface, and indusium all minute, stellate; segments not ciliate; texture subcoriaceous T. sclerophylla
Hairs of costae, leaf surfaces, and indusium mostly simple or forked above base; segments long-ciliate with simple hairs; texture membranous..... T. reptans

Smithsonian Institution, *Washington, D. C.*

Notholaena arequipensis Maxon, a Fern New to Chile

GUALTERIO LOOSER

Mr. Óscar Barros V., who took part as ornithologist in an expedition sent by the University of Chile to the northernmost part of Chile, collected some plants and gave me a few specimens of a *Notholaena* that I recognized at first sight as being a new species for Chile. After a careful study, I became convinced that it was *N. squamosa* (Gill. ex Hook. et Grev.) Lowe, or better, *N. arequipensis* Maxon. To be certain that it could not be another species of the neighboring countries of Peru,

[1] The author of the species is given as Poeppig by Sprengel, presumably an error corrected by Kunze in the amplified description published in Linnaea.

[2] Under *Thelypteris*, *T. tetragona* (Swartz) Small is the valid name; under *Dryopteris* the name *D. subtetragona* (Link) Maxon must be used.

Bolivia, and Argentina and unknown to me, I sent a specimen to Mr. C. A. Weatherby, the distinguished pteridologist, who was always exceedingly kind in answering my botanical queries, and who specialized in the study of the South American *Notholaena.* Mr. Weatherby confirmed that it was *N. arequipensis* Maxon.[1] This species has been collected very seldom. It was only known from Arequipa, in southern Peru (Type: Tingo, *J. N. Rose* coll.) and recently Mr. Weatherby[2] indicated it from the northernmost part of Argentina.[3] The specimens brought by Mr. Barros were collected growing in the shadow of a big stone near San Andrés de Pachama, Department Arica, Chile, alt. 3900–4000 m., lat. 18.5° S., March 3, 1948. This discovery of Mr. Barros, besides representing a new species for Chile, points out an interesting intermediate station between Arequipa and Jujuy, which are separated one from the other by about 1000 km.

Notholaena arequipensis differs clearly from *N. squamosa* by the lack of piliform scales on the upper surface of the blade, and from the other Chilean species it also differs by the abundant broad scales, for in the other Chilean *Notholaenas* there are only hairs or waxy exudations.

Santiago, Chile.

[1] Smiths. Misc. Coll. 65(8): 9. 1915.
[2] Lilloa 6: 272. 1941.
[3] Province Jujuy, Moreno, *R. E. Fries* coll.

Recent Fern Literature

Professor Irene Manton, of the University of Leeds, has just published a book[1] on pteridophytes of surpassing interest to students of these plants. The new tech-

[1] Problems of Cytology and Evolution in the Pteridophyta. I. pp. i–xi; 1–316, plate, figures 1–279, tables 1–9, appendices I–IV, bibliography, index. 1950. London and New York: Cambridge University Press. $8.50.

niques which she has successfully applied to the solution of species problems are likely to lead to alterations of our concepts of some of the commonest and most familiar ferns. These techniques are those of cytotaxonomic analysis—the solution of problems of evolution by investigations of chromosome structure and behavior. Prof. Manton has spent eighteen years at this revealing study. She presents numerous figures and photographs of the chromosomes and other features of British pteridophytes as well as other non-British species in connection with special problems like hybridity and apogamy. These excellent illustrations, combined with much valuable information and a readable style, make it a volume which not only should be included in libraries of professional pteridologists, but one which may be desired by serious non-professionals as well.

The conclusion which emerges emphatically from this book is that the pteridophytes can very profitably be analyzed from the evolutionary standpoint by studying their chromosomes. The chromosome number alone may be highly significant in showing relationships at the generic level (a lively present-day problem, in my opinion, as witnessed by the differing interpretations of such authors as Copeland, Holttum, Dickason, and Ching). Thus, Manton found that *Polystichum, Dryopteris* (in the strict sense), and *Cyrtomium* all have a base number of 41 chromosomes, which suggests that they are rather closely related. The three species of *Athyrium* which she examined have 40 chromosomes as the gametic or *n* number—a number closer to that of *Dryopteris* than of *Asplenium*. The segregation of the three genera *Thelypteris* (*Lastrea*), *Gymnocarpium*, and *Phegopteris*, which were put into *Dryopteris* in the past but are now separated from it by most authors, is justified by Manton's researches so far, in that their chromosome numbers are different from that of *Dryopteris.* The species of *Asplenium, Scolopendrium,* and *Ceterach* proved all to have a basic number of 36 chromosomes.

Another significant gain has been to show quite conclusively that many of the suspected fern and horsetail hybrids of Great Britain almost surely resulted from crosses of different species. The evidence for this rests on the phenomenon of pairing of chromosomes. In a hybrid the *n* complements of chromosomes of different species when brought together by crossing usually lack the ability to pair. When spores are produced by the hybrid there is an upset in the migration of the chromosomes, and the spores are unbalanced and abortive and usually fail to germinate if they form properly at all. By making observations of the pairing behavior in such putative hybrids as *Asplenium germanicum* (*A. septentrionale* × *A. Trichomanes*), *Dryopteris dilatata* × *D. spinulosa, Woodsia ilvensis* × *W. alpina,* and *Equisetum litorale* (*E. arvense* × *E. limosum*) Manton showed that chromosome sets from different species must be present.

Such hybrid ferns can reproduce by spores only if the pairing ability of normal species can be re-acquired, and this has apparently happened in some cases, by automatic doubling of the entire group of chromosomes. Each basic *n* set from each parent is thereby matched, and pairing takes place normally. This was strongly suggested to be the case in the plant known as *Scolopendrium hybridum,* a putative hybrid between *Ceterach officinarum* and a species of *Scolopendrium.*[2] One of the most surprising results of Manton's study has been

[2] I might suggest that such very interesting hypothetical hybrids in the N. American flora as *Aspidotis californica* × *Onychium densum* detected by the late Mrs. Carlotta C. Hall in Marin Co., California; *Polystichum californicum* (*P. Dudleyi* × *P. munitum*); *Cystopteris fragilis* × *bulbifera; Asplenium pinnatifidum* (*A. montanum* × *Camptosorus rhizophyllus*), *Dryopteris Clintoniana* (*D. cristata* × *D. marginalis*) and a variety of others offer themselves for examination from this standpoint.

to show that such familiar ferns as *Cystopteris fragilis, Polystichum aculeatum,* and typical *Dryopteris Filix-mas* seem also to be hybrids in origin. Another series of findings reveals that *Asplenium Trichomanes* and *Dryopteris dilatata* occur in two strains each, a diploid (*2n*) and a tetraploid (*4n*). And *Polypodium vulgare* of Europe turns out to comprise *2n, 4n,* and *6n* populations, the last with 222 chromosomes and possibly the hybrid of the *2n* and *4n*.

The researches of Döpp on obligate apogamy of ferns have been confirmed and amplified by Professor Manton. This non-sexual life-cycle, which is already known to exist in various American ferns such as *Pellaea atropurpurea* and *Asplenium resiliens* (the latter unpublished), is currently being found in other ferns in various laboratories. It involves two major steps: the doubling of the chromosome number before spore formation (giving the spores the *2n* number) and the direct formation of new sporophytes from the *2n* gametophytes. If a hybrid fern has this type of life-cycle, with doubling of chromosome number just before spore formation, then pairing will be normal, and viable spores can be produced. In each of the ten different apogamous ferns in such different genera as *Pellaea, Cyrtomium, Pteris,* and *Asplenium* which Manton studied, this process occurred. Moreover, in all of them she suspected hybridity, since the fraction of sporangia which did not have doubling of the chromosome number had little or no pairing. In fact she was led to the conclusion that hybridization is a cause of apogamy. For the three apogamous species of *Cyrtomium* she postulated an original ancestral hybrid fern which was also apogamous, and from which the three species evolved by genic mutation.

A rather complicated situation arises from the fact that apogamous ferns can evidently hybridize with sexual ferns since the *2n* sperms are apparently functional. This seems to be the case in at least some of the *2n, 3n, 4n,* and *5n* populations and individuals of the apogamous hybrid, *Dryopteris Borreri.* This, therefore, is another mechanism which should be added to those listed by Benedict[3] that make possible the production of offspring by hybrid ferns.

These investigations will obviously have an important effect on the taxonomy of pteridophytes and on the knowledge of their evolution. Such research, however, presents numerous difficulties. The ordinary *Lycopodium Selago,* for instance, revealed at the time of spore-production that the actual number could not be counted because there were over 260 chromosomes, many of them unpaired, and of peculiar antenna-like forms. It was the most difficult cytological object which Manton encountered. The well-known adder's-tongue, *Ophioglossum vulgatum,* was shown to have a sporophytic number of over 500, the highest chromosome number yet reported in a wild species in the plant kingdom. Technical problems like these, as well as the high degree of accuracy required in such studies, were met squarely by the author, who adopted the rule that what could not be photographed could not be used as evidence. What makes the researches of Manton even more admirable is that they were seriously interrupted by World War II when many valuable plants under investigation were lost by necessary neglect and by air-raids.

A volume of this varied nature naturally cannot be reviewed briefly in its entirety. The seventeen chapters include such titles as "The Psilotales," "The Ancient Ferns," and "Induced Apogamy," and the last chapter, which summarizes the author's conclusions, contains elements of unusual theoretical interest to students of Pteridophytes. There are also four appendices: on the

[3] This JOURNAL 35: 71–72, 1945.

cytological techniques, the photographic techniques, the principal new facts recorded, and a complete list of the chromosome numbers. Although the author's conclusions may meet with disagreement on certain points, this itself will add to the value of the book in ushering in and spreading wide a valuable new approach to the study of ferns. This approach is one which contributes fundamentally to the related work of morphologists and taxonomists, and supplements our knowledge from a new standpoint. The volume is one of the most important works in pteridology in recent years.—WARREN H. WAGNER, JR., Gray Herbarium, Harvard University.

Another state fern flora.[1]—The latest addition to the growing list of state fern floras is a 96-page pamphlet on the Pteridophytes of Colorado. It covers 63 species and varieties, with keys for and descriptions of the families, genera and species represented. One taxon, *Onoclea sensibilis,* was first found in the state while the bulletin was in press.

Line drawings, by Professor Durrell, are given for all the species. Many of them are excellent, but some are disappointing. No indication is given as to the degree of enlargement they show, and some tiny ferns actually occupy a greater space than huge ones, (*cf.* for example the *Botrychia* on page 10) which is likely to mislead the amateur or beginner. In the cases of the *Athyriums, Dryopteris dilatata, Lycopodium annotinum,* and others, the characters are not well brought out.

In a state flora one normally hopes to find information as to the distribution and habitat of the taxa which may aid in locating occurrences of the rarer or more notable ones. Here these matters are briefly and not always accurately described; too often taxa are stated to grow

[1] Colorado Ferns. H. D. Harrington and L. W. Durrell. Colorado Agricultural Research Foundation, Fort Collins, Colo. 1950. $1.00.

merely "among rocks" or "in rocky soil." Unjustified inferences can accordingly be drawn, and have been, as when on page 26 it states that *Asplenium viride* "should be found anywhere in the mountainous portions of the state." Actually this boreal limestone-inhabiting fern can only be expected on outcrops of calcareous rocks in especially bleak situations, and therefore, only extremely locally; the reviewer found it but once, in the course of fairly thorough explorations over the state, and keenly recalls the stiff climb to a huge bluff of quartz rock, and the finding of the little green spleenwort tucked away in crevices of limestone into which the silica had intruded.

The booklet closes with a full glossary and index; one of the subsequent blank pages might well have been occupied by a list of notable previous publications on Colorado ferns. Perhaps a leaflet listing typographic errors might be tipped in on one of these pages also.—EDGAR T. WHERRY.

Dr. Jesse M. Shaver, of George Peabody College for Teachers, Nashville, Tennessee, is the principal authority on the ferns of Tennessee. Some of his earlier studies have been noted in the Journal (vols. 33, 34, 35, and 37). The papers that have not been noted are: "The Southern Lady Fern, the New York Fern, and the Marshfern,"[1] "A Study of the Tennessee Ferns Belonging to the Genus Dryopteris,"[2] "Tennessee Ferns of the Genera Phegopteris, Polystichum, and Cystopteris,"[3] "A New Fern, Cystopteris tennesseensis sp. nov., from Tennessee,"[4] and "Tennessee Ferns of the Woodsia Group."[5]

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[1] Journ. Tenn. Acad. Sci. 21: 297–318. 1946; 22: 255–256. 1947.

[2] *Op. cit.* 22: 257–302. 1947; 23: 111–119. 1948.

[3] *Op. cit.* 23: 123–130, 258–274. 1948; 24: 179–194. 1949; 25: 96–104. 1950.

[4] *Op. cit.* 25: 106–113. 1950.

[5] *Op. cit.* 25: 141–142. 1950 (to be continued).

Dr. Shaver's work is careful and thorough; as Dr. S. F. Blake remarked,[6] his treatment is altogether the most elaborate publication on ferns in American literature. The only unfortunate feature is that the publications should not have a wider circulation among fern students. If these papers could only be all brought together in book form when the work is completed they would undoubtedly be among the most frequently consulted and cited works.

The treatment is conservative in general. *Dryopteris campyloptera* is recognized as a distinct species, a decision with which the reviewer can not agree, although he would not quarrel with calling it *D. dilatata* [or *D. austriaca*] as distinct from *D. spinulosa*. The characters by which *D. campyloptera* was separated from *D. dilatata* appear minor and, in the opinion of the reviewer, do not always hold true by any means. The color of the scales is variable as is also the glandularity. *Dryopteris Clintoniana* is reported from Tennessee with doubt on the basis of two old and fragmentary specimens collected long ago by Gattinger. *Dryopteris Clintoniana* × *Goldiana* [*D. celsa*] is reported from a few stations, a considerable extension of range, for this plant has been known heretofore only from the coastal plain, so far as the reviewer is aware.

Although Dr. Shaver maintains *Athyrium asplenioides* as a species, he points out that Tennessee specimens show many characters of *A. angustum* and he concludes "The similarities of these two ferns are so great and the differences so minor that at most they should be varieties. It may well be that to call them forms would be more accurate than to call them varieties," an opinion in which the reviewer concurs.

Dr. Shaver's treatment includes detailed descriptions.

[6] THIS JOURNAL 40: 164. 1950.

distributional maps, photographs of the plants *in situ*, and most excellent line drawings with magnified details. —C. V. M.

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American Fern Journal

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Notes on Three Australasian Ferns

MARY D. TINDALE

Recent studies have clarified the status of the following three ferns.

CYATHEA LINDSAYANA

Sir William Hooker described[1] *Cyathea lindsayana* Hook. from material said to have been collected on Mount Lindsay (on the border between New South Wales and Queensland, Australia), and forwarded by Walter Hill. The three pinnae obtained by Hill are now in the herbarium of the Royal Botanic Gardens, Kew (except for a fragment sent to the National Herbarium, Sydney, in 1915). They appear to be the sole record of the species. No further specimens from Australia are in the British Museum nor in any of the Australian herbaria. Although botanists have collected ferns on Mount Lindsay quite recently, they have failed to locate this species again. However, much of the dense rain-forest on the slopes of the muntain must still be unexplored.

The type of *C. lindsayana* matches perfectly the type of *Cyathea Grevilleana* Mart.,[2] i.e. Jamaica, *Greville*, 1832, Herb. Mart. (Jardin Botanique de l'Etat, Brussels). Hill's specimens have been compared also with other specimens from Jamaica, i.e. *Orcutt* 6078, *Harris* 7725, and with specimens recently collected by George R. Proctor (nos. 3962, 4815, 4909, 5061). I suggest that

[1] In Hook. & Bak. Syn Fil. 25. 1865.

[2] Mart. Icon. Plant. Crypt. 78. 1834.

[Volume 41, no. 3, of the JOURNAL, was issued October 3, 1951.]

Jamaican specimens were mixed with those collected by Hill at Mount Lindsay, as it is unlikely that a fern from the West Indies would occur in Australia, unless cultivated. Hill's correspondence with Hooker does not clarify the matter, as he only mentions that "he hopes to send a better account of the ferns found at Mount Lindsay." This species must be known as *Cyathea Grevilleana;* whether or not the specimens were really collected on Mount Lindsay is a matter of conjecture.

The holotypes of *C. lindsayana* and *C. Grevilleana* are both characterized by small, brown, fawn or yellowish, bullate costal scales, these surmounted by a tuft of several dark-red spinules and also furfuraceous brown scales with a terminal dark-red spinule and a dark brown central band. Towards the apices of the pinnules there occur a number of stiff, yellow, unbranched hairs, each consisting of a single row of cells. The deeply cyathiform indusia each open by an apical pore. The conical or globose, minutely gray-furfuraceous receptacles and the margins of the ultimate segments are identical in the two holotypes.

Cupuliform indusia combined with the above types of scales and hairs do not occur in many species of *Cyathea sens. lat.* but are characteristic of a group of Central American tree ferns. *Cyathea nigrescens* (Hook.) J. Smith and *C. tenera* (J. Smith) Moore are also members of this group.

ALSOPHILA LODDIGESII KUNZE

Alsophila Loddigesii Kunze[3] is represented at Kew by a specimen labelled in Kunze's hand "*Alsophila Loddigesii* Kze., *Dicksonia squarrosa,* Lodd. H. bot. Lips. 44, sententiam tuam expeto," which I am choosing as lectotype. Kunze's own specimens were lodged in the Botanical Institute of the University of Leipzig. Mr. A.

[3] Linnaea **20**: 7. 1847.

H. G. Alston, in his "Report of the State of Taxonomic Botany and Botanical Collections in some areas of Germany since 1939," stated that the Botanical Institute was completely destroyed. I do not know if any specimens were saved.

The syntypes of *Cyathea australis* (R. Br.) Domin[4] are in the British Museum; they are "King's Island, Bass Strait, *R. Brown* 94, 1802," and "Port Jackson, *R. Brown* 95, 1802–5." Both are labelled in Brown's hand, but the latter is named *Alsophila australis β*, so I choose the former as lectotype. From a comparison of the lectotype of *Alsophila Loddigesii* with the syntypes and with other specimens of *C. australis* it is evident that the two are conspecific, so *A. Loddigesii* must be regarded as a synonym.

Both lectotypes are characterized by fawn or light brown, bullate costal scales (which often have long, fibrillose apices), as well as by numerous, unbranched, reddish paraphyses, each composed of a single row of cells. Other points of similarity are the woolly hairs on the upper surface of the secondary rhachises, the hemispherical indusia composed of a series of fawn, fimbriate scales, and the light stramineous lower surface of the rhachises. It is true that the ultimate segments are rather broader at the base in the pinnules of *A. Loddigesii*, but this is sometimes the case in *C. australis*, e.g. N.S.W. no. P1415, Jerseyville, Macleay River, *J. L. Boorman*, June, 1910.

Cyathea australis is a fairly common species in eastern Australia; it occurs in southern Queensland, New South Wales, Victoria, and Tasmania. In herbaria it is frequently misidentified as *C. Cooperi* (Hook. ex F. Muell.) Domin, but the latter is easily distinguished by the dendriform scales on the costae.

[4] i.e. *Alsophila australis* R. Br. Prodr. Fl. N. Holl. 158. 1810.

CTENOPTERIS HETEROPHYLLA

CTENOPTERIS **heterophylla** (Labill.) Tindale, comb. nov.

Grammitis heterophylla Labill. N. Holl. Plant. Sp. **2**: 90. *fig. 239.* 1806. HOLOTYPE (Univ. of Florence): "Terra Diemen, Herb. Webbianum, ex Herb. Labillardière." Labillardière's original description in his own handwriting is affixed to this sheet, which has three specimens with rhizomes (*v.*).

Polypodium grammitidis R. Br. Prodr. Fl. N. Holl. 147. 1810; Benth. Fl. Austr. **7**: 764. 1878; Moore & Betche, Handb. Fl. N. S. W. 514. 1893; Ewart, Fl. Vict. 46. 1930. HOLOTYPE (BM): "Arbor . . . in caudex *Dicksonia,* Derwent, *R. Brown,* Iter. Austr. 1802–05 (*v.*). ISOTYPE (KEW): Derwent, *R. Brown,* no. 13, Iter Austr. 1802–05 (*v.*).

Xiphopteris heterophylla Spreng. Syst. Nat. Veg. $\mathbf{4}^1$: 44. 1827. Based on *Grammitis heterophylla* Labill.

Gymnogramma Billardieri Kaulf. Wes. d. Farrnkr. 81. 1827. Based on *Grammitis heterophylla* Labill. *Nom. illegit.* (Nom. Rules Art. 60. 1).

Polypodium Billardieri Fée, Gen. Fil. 236. 1850–52 (non *P. Billardieri* R. Br., 1810). Based on *Grammitis heterophylla* Labill. *Nom. illegit.* (Nom. Rules Art. 60. 3).

Grammitis grammitidis (R. Br.) Keys. Pol. Cyath. Herb. Bung. 34. 1873. (Attributed to R. Br. in error.)

Ctenopteris grammitidis (R. Br.) J. Smith, Hist. Fil. 185. 1875; Crookes, in Trans. et Proc. Roy, Soc. N. Z. $\mathbf{77}^2$: 225. 1949. Based on *Polypodium grammitidis* R. Br. and *Grammitis heterophylla* Labill. *Nom. illegit.* (Nom. Rules Art. 60. 1.)

Rhizome very shortly creeping, 2–7 mm. broad, densely clothed at the apex with shortly acuminate, ± entire, clathrate, narrowly lanceolate (6 : 1) to lanceolate (3 : 1) scales (2.5–3 mm. long and 0.5–0.75 mm. broad) which are pale ferrugineous or dark gray near the apex and chestnut-brown near the base; roots black, wiry and numerous. *Stipes* rather crowded on the rhizome, alternating in two close rows, 1–5 cm. long, 0.2–1.5 mm. broad near the middle, wiry, light green or light brown, broadly winged to the base, glabrous or with a few hairs which are simple or once or twice branched, translucent or light red with red-brown joints; insignificantly articulated to the rhizome. *Main rhachis* winged by the long-decurrent bases of the pinnae, light green or light brown; glabrous or, especially on the lower surface, clothed with a few, scattered hairs of the same type as on the stipes. *Fronds* variable in shape and size, from 2.5–35 cm. (mostly 5–26 cm.) long including the stipes, pinnate to pinnate-pinnatifid or more rarely simple with an irregularly crenate margin in young fronds, subcoriaceous to coriaceous or sometimes herbaceous, the simple fronds cultrate-elliptic (9 : 1) to linear (15 : 1), 0.3–0.5 cm. broad, the pinnatifid fronds 1–10 cm. broad (mostly 2.5–6 cm.), linear (more than 12 : 1) to very narrow elliptic (6 : 1) to broadly elliptic (3 : 2), the apex often terminating in a caudate segment 1.4–3.5 cm. long and 1.5–3 mm. broad; base of fronds gradually tapering into the stipes. *Pinnae* sessile, each attached by a long-decurrent base, irregular in length, giving an irregular outline to the frond (but longest pinnae usually towards the center of the frond), distant, erect-patent, falcate, 7–20 pairs, 2–6 cm. long and 1–15 mm. broad towards the middle, linear (more than 12 : 1) to narrow oblong (3 : 1); apex obtuse, subacute, truncate or broadly rounded; margin lobed or pinnatifid with cuneate-truncate to cultrate segments. *Veins* free, hidden in the thick texture of the lamina, the costae with a few, simple or branched hairs; costules once- or twice-forked or simple in the smaller lobes or pinnae, not reaching the margin, each ending in a hyda-

TASMANIAN SPECIMEN OF CTENOPTERIS HETEROPHYLLA thode. *Sori* exindusiate, superficial, 10–350 pairs, usually 100–200 pairs, 1–2.2 mm. long, 0.5–1 mm. broad, rarely only 0.2 mm. broad, closer to the margin than to the midrib, very slightly oblique, slightly sunken, usually one sorus at the base of each lobe, rarely 2 to 4 sori per segment, terminal or almost so on the minor veinlets or on the upper and inner fork of the minor veinlets, oblong (2 : 1), very broadly oblong (6 : 5), rounded (6 : 5), or orbicular (6 : 6), rarely cultrate (6 : 1). *Sporangia* non-setose, borne on rather long pedicels one cell broad at base; annulus composed of 9 to 12 cells. *Spores* globose-tetrahedral, slightly tubercular, without an epispore, polar diameter $36\,\mu$–$49\,\mu$, largest equatorial diameter $36\,\mu$–$52\,\mu$, wall $1\,\mu$ in thickness.[5] *Paraphyses* absent.

The above description is based on Australian specimens.

SPECIMENS STUDIED:[6]

AUSTRALIA:

VICTORIA: Combienbar River, *N. A. Wakefield,* Apr. 14, 1938 (N.Q.N.C.). Lorne, *W. W. Watts,* November, 1919 (N.S.W. no. P3541). Otway Ranges, *H. B. Williamson,* December, 1903 (N.S.W. no. P3543). Without specific locality, *F. Mueller* (N.S.W. no. P3542).

TASMANIA:

NORTHEASTERN: St. Patrick's River, *R. C. Gunn* 1543, Apr. 1, 1845 (N.S.W. no. P6053).

WESTERN: Wet rocks, Macquarie Harbor, *A. Cunningham* 131 (KEW). Pine Cove, Macquarie Harbor, *A. Cunningham* 131 (KEW).

SOUTHEASTERN: Mount Nelson, July, 1931, *E. Rodway* 149 (KEW). Dunn's Creek, Summerleas, August,

[5] The spores were boiled in a 10% solution of KOH for two minutes and mounted in glycerin before measurements were taken in N.S.W. Nos. P5906 and P3541.

[6] The following abbreviations for herbaria are used: N.S.W., National Herbarium, Sydney, New South Wales; N.Q.N.C., North Queensland Naturalists' Club Herbarium, Cairns; BM, British Museum (Natural History); KEW, Royal Botanic Gardens, Kew.

1930, *E. Rodway* 96; Aug. 8, 1931, *E. Rodway* 173 (KEW). Eaglehawk, *A. H. S. Lucas,* October, 1924 (N.S.W. no. P3670). Hospital Bay Hill, S. Huon, *Oldfield,* June, 1887 (KEW). Small island, Recherche Bay, Dec. 18, 1938, *R. C. Gunn* 1543 (N.S.W. no. P6051). Recherche Bay, *G. & C. Davis,* January, 1937 (N.S.W. no. P5906).

Chatham Island: *Travers* 74 (KEW).

New Zealand:

North Island: On decayed timber, Great Forest of Hokianga, *R. Cunningham* in 1834 (KEW).

South Island: Prov. Canterbury, *Sinclair & Haast* (KEW). On rocks and trees, east side of S.I., Acheron, *Lyall,* April, 1850 (KEW). Otira, Westland, epiphyte in forest, *N. Lothian,* April, 1937 (KEW). Franz Joseph Glacier, *M. D. Glynne* (KEW). Milford Sound, near sea level in thick "bush," *M. D. Glynne* (KEW). Bluff, *Leland, Chase & Tilden,* February, 1910 (KEW). Without specific locality, *Colenso* 154, 278, 762, 1033, 1471 (KEW).

This species is an epiphyte in rain-forests. There appears to be no obstacle to the use of Labillardière's epithet *heterophylla,* which antedates *Polypodium grammitidis* R. Br. by four years.

The salient features of the genus *Ctenopteris* were enumerated by E. B. Copeland[7] and by R. E. Holttum.[8] This species appears to be a typical member of the genus, as shown by the following characters. The stipes alternate in two close rows on a very shortly creeping rhizome. The hairs of the stipes are typical, i. e. multicellular with a few branches. The scales of the rhizome have uniform cell-walls, and the margins are entire or with a few, short, rounded protuberances. As a rule, these scales are not

[7] Gen. Fil. 218. 1947.

[8] Biol. Rev. **24**: 283. 1949.

concolorous, as in many species of this genus. The fronds are more or less elliptical, simple to pinnate-pinnatifid, and very insignificantly articulated to the rhizome. Other important features are the free veins, the simple, once- or twice-forked costules, the rounded or oblong, non-indusiate, slightly immersed sori, the naked sporangia, and the globose-tetrahedral spores without epispore.

The known distribution includes Victoria, Tasmania, Chatham Island, and New Zealand. I have not seen any specimens from New South Wales, but the species is abundant on the Genoa River, which is about ten miles from the border of New South Wales.

The specimens from New Zealand are characterized by more numerous pinnae (16–32 in the specimens at the British Museum, 5–31 in those at Kew, and 6–67 in those at the National Herbarium, Sydney). A notable exception is the specimen collected in Victoria by F. Mueller (N.S.W. no. P3542), in which there are from 10 to 72 pinnae per frond. The scales of the rhizome in the specimens from New Zealand are much yellower than in those from Australia, except in the Mueller specimen cited. In Australian material the scales are clathrate and dark steel-gray, although some of the younger scales are brownish. However, grayish-brown, clathrate scales do occur on the rhizomes of some specimens from New Zealand (e.g. the Leland, Chase & Tilden and Sinclair & Haast specimens cited above). In both these specimens there are very numerous pinnae. The bases of the stipes are generally more hairy than in Australian material, although very pubescent stipes do occur in some Tasmanian specimens (e.g. the Lucas specimens cited above). These hairs are of exactly the same type in material from both regions.

It is evident that there is a cline in this species. The

Australian material is characterized by fewer pinnae, grayish clathrate scales of the rhizome, and stipes which are usually glabrous or with a few scattered hairs. The material from New Zealand has numerous pinnae, yellowish scales with unthickened cell-walls, and in many cases very pubescent stipes. As noted above, however, there are intermediates. There are specimens from New Zealand collected by Fraser and Colenso which are comparable to those from Australian rain-forests. This is also true of the specimen collected by Travers on Chatham Island, which is off the east coast of New Zealand.

I wish to thank the following botanists for their generous assistance: Dr. P. Brough, formerly of the Department of Botany, University of Sydney; Mr. R. H. Anderson, Chief Botanist and Curator, National Herbarium Sydney; Dr. W. Turrill, Keeper of Botany, Royal Botanic Gardens, Kew; Dr. J. Ramsbottom, former Keeper of Botany, British Museum; Dr. C. Metcalfe, Kew; Mr. George R. Proctor, Institute of Jamaica; Dr. H. Flecker, of Cairns; Mr. K. Mair, of Sydney; and Prof. W. Robyns, of Brussels. I am particularly grateful to Dr. R. Pichi-Sermolli, who compared one of my specimens with the type of *Polypodium grammitidis* R. Br. in the British Museum before I was able to go to England.

NATIONAL HERBARIUM, SYDNEY, AUSTRALIA.

Is Thelypteris reducta Small a Valid Species?

MARY W. DIDDELL

After careful and intensive study of the two species, *Thelypteris reducta* Small and *T. dentata* (Forsk.) St. John, I have come to the inescapable conclusion that they are one and the same species.

Early in 1939, a friend, returning from a trip to Brazil, brought me a few fern specimens for my herbarium, which she had collected near Rio de Janeiro. There were three or four entire, small plants with good roots, which appeared still to have some life and as they had been out of the ground only about a week, I set them in a pan of water over night, then potted and set them out in the greenhouse. Only one survived, which turned out to be *Thelypteris dentata.*

In the winter of 1941–42, I made several trips down into the lime sink region between Gainesville and Ocala, where I collected a few small plants of *T. dentata,* and I also collected another one which I found growing within the city limits of Jacksonville; all of these I brought home and planted in my fern garden. About mid-spring of 1942, I took the Brazilian plant, which had grown considerably, out of the greenhouse and planted it in the garden, but in a place entirely apart from the Florida plants of *T. dentata,* so that I would not confuse them and could observe any differences.

Several weeks later I noticed that the Brazilian plant was producing sporophylls so entirely different from any of the previous ones and from those of the native plants of *T. dentata,* that I took a sporophyll off of the Brazilian plant and from one of the Florida plants and sent them to Dr. Maxon with the query, "Are these the same species?" Dr. Maxon replied that they were both *Dryopteris dentata* (Forsk.) C. Chr., as with his habitual conservatism, he retained the old, comprehensive genus *Dryopteris*.

A few weeks later, a friend brought me two large plants of *Thelypteris reducta* Small, which he had collected in the Bowling Green area of Florida, at approximately the same place where Dr. Small collected his specimens. To my surprise, they seemed identical with the Brazilian plant.

Since the summer of 1942, I have grown hundreds of these plants from spores, unintentionally, however, as they appear all over the greenhouse—under the benches, indiscriminately in pots of anthuriums, which are always kept wet, and in pots of cacti, which are seldom watered; in every sowing of fern spores of whatever species, a percentage of the sporophytes will be *T. dentata*. As the species is easily recognized, at least by the appearance of the third tiny frond, I often take the sporelings from the greenhouse and set them in the garden, where they make a good background behind the pool and other places; where they do not encroach on other plants, some are left in the greenhouse.

Now, the specific differences between *T. reducta* and *T. dentata,* as described by Small, are in the sub-dimorphism and the reduced lower pinnae of the former. In *T. reducta,* the sterile fronds are ovate-lanceolate, the lower one to two pinnae reduced, and each pinna closely adjacent to its neighbor. The sporophylls are much taller than the sterile fronds, the pinnae shorter and more widely spaced, with the three to five lowest pairs reduced. After a time I noticed that all of the Florida plants I personally collected, and the oldest of those grown from spores, were producing fronds identical with those of the Brazilian plant and the two plants of *T. reducta* from Bowling Green. Then I noticed something else: In the fall, new fronds come out, all of them comparatively short, ovate-lanceolate, with closely set pinnae, the one to two lowest ones reduced and these continue to appear through winter and spring, *but always some of them* will bear sori. With the arrival of the long, hot days and the copious rains of summer, the tall, slender, "sub-dimorphic" sporophylls with widely spaced pinnae with the three to five lowest pairs reduced appear; a plant will produce from three to eight of these fronds, then rest during the maturation of the spores and in the fall start the cycle over again with the production of the short, "sterile" fronds.

Those plants which I did not bother to remove from the cactus pots, those which have remained under the benches where the soil is poor and only get watered indirectly from the drips from the potted ferns above them, and those which somehow got under some flowering plants outside, which overtopped and overcrowded them, have all produced spore-bearing fronds, but *never* the typical "reducta" fronds. On all plants of *reducta* and *dentata,* no matter where nor how grown, the rhizome, basal scales, and hairs on the blade are identical.

Small published his species *Thelypteris reducta* in his "Ferns of the Southeastern States," and in his remarks following the description, he states that *T. reducta* always grows in wetter places than *T. dentata* and also that it is larger. This bears out my observations that the plants in poor soils, or scantily watered, or in full sun, or in too much shade always produce fronds that are exactly alike except that some of them bear sori, while plants in rich soil, plentifully watered, and with advantageous conditions of light and shade are much larger and produce the tall, summer sporophylls. By reason of the greater elongation of the rachis, the pinnae would naturally be shorter and more reduced below and spaced wider apart. In a given plant, the elongated sporophylls have exactly the same number of pinnae as the short fronds.

Further, in his remarks on *T. reducta*, Small says, "A specimen collected by Tsang, in China, duplicates the typical characters of the Florida plant." In my herbarium, I have a specimen sent to me from New Zealand, which is perfectly good "T. reducta," and I have also the above described Brazilian plant. In Dr. Maxon's "Pteridophyta of Porto Rico and the Virgin Islands," his description of *Dryopteris dentata* fits in every detail the plant called *Thelypteris reducta* Small.

On first thought one might be surprised that this phase of the plant has not been noticed more frequently, but it is a fern that is rarely cultivated; the dimorphic form is rarely collected because it can be found only in the summer, when, because of the hot weather, high water in the swampy area, mosquitoes, and the snakes, few people venture out collecting. In the winter and spring, when most collecting is done, the tall summer sporophylls will have fallen to the ground and disintegrated.

In Ching's excellent work "On the Natural Classification of the Family Polypodiaceae," he transfers *T. dentata* to the genus *Cyclosorus* Link, which includes those species heretofore referred to *Thelypteris,* which have simple hairs and the basal veins of adjacent segments united into one vein excurrent to the sinus.

Thelypteris reducta Small should be reduced to synonymy, with neither sub-specific nor varietal status. I very much dislike having to question the validity of one of Dr. Small's species, but he saw the living, mature plants as they were growing in the swamp, perhaps only once, certainly not more than a few times; I have studied them carefully from the first appearance of the tiny frond on the prothallus through the changing seasons over a period of years.

Jacksonville, Florida.

Duration of Viability of Spores of the Osmundaceae

ALMA G. STOKEY

The viability of the spores of the Osmundaceae is considered to be of short duration, as seems to be the case generally with chlorophyll-bearing spores. Under ordinary conditions of keeping spores this is undoubtedly true; the viability is measured in days and weeks rather than in months and years, as may be the case with many spores without chlorophyll. However, Lagerberg[1] found that the spores of *Osmunda regalis* L. may be viable for two months; and Gerhardt[2] gave the results of some tests made on spores of *O. regalis,* but did not state the conditions under which the spores were kept. He found that the germination time increased with the age of the spores: spores three days old germinated in one day; 34 days old in four days; 130 days old in seven days; 150 days old in 20 days; and no germination in 225 days.

In the early summer of 1947, when some plans for an extensive study of the gametophyte of the Osmundaceae required viable spores in the autumn, it seemed desirable to try to keep spores by the method of refrigeration which has been successful with pollen grains. To obtain a later collection than might be available to the author, fertile fronds of *O. Claytoniana* L. were sent June 12, 1947 by Dr. Hannah Croasdale, from Hanover, New Hampshire to Woods Hole, Massachusetts. They arrived in fresh condition wrapped in damp paper toweling and in a cardboard box; they were at once put into an electric refrigerator. Some fertile pinnules of *O. regalis* collected

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[1] Lagerberg, H. Morphologische-biologische Bemerkungen über die Gametophyten einige Schwedischer Farne, Swensk. Bot. Tidskr. 2: 229–276. 1908.

[2] Gerhardt, E. Untersuchungen über die Vorkeimentwickelung einiger einheimischer Farne. Diss. Marburg. 1927.

July 6, 1947, at Teaticket, Massachsetts, by Dr. Harry N. Stoudt, were wrapped in smooth white typewriter paper and placed in the same box in the refrigerator. A collection of spores which was wrapped in wax paper did not retain its viability as long as the other two.

Tests of the viability of the spores were made at intervals, by scattering a small amount of the spore material on the surface of distilled water in small petri dishes. The spores could then be examined from day to day in the open petri dishes under the low power of the microscope. The spores were considered to have germinated when the spore coat ruptured and there was a tapering protrusion of the young thallus, the beginning of the first rhizoid. At first, tests were made every week, and then every two weeks, until late September. At that time germination about was rapid as with fresh spores and the percentage of germination was very high. The refrigeration was then continued out of curiosity as to how long the viability of the spores would continue. During the course of the "experiment" the spores were removed from the refrigerator for intervals of 15–20 minutes whenever tests were made, and for periods of five or six hours in October and in June for transport to and from South Hadley. They were kept first in a refrigerator at the Marine Biological Laboratory, then in three different refrigerators at Mount Holyoke College; the spores experienced a range in temperature during refrigeration from 2°C to 6°C, according to the refrigerator and the place in it.

At the end of nine months the rate of germination was slower and the percentage of viable spores had decreased to 70–75. The estimates were made by counting the live and dead spores floating on the surface of the water in several fields of the microscope. In April, 1948, it required three or four days, or even longer, for the stage of germination to be reached which would be attained by fresh spores in two or three days. With the aging of the spores not only did the minimum time of germination become longer, but germination extended over a much longer period than is the usual range with fresh spores. In the refrigerated material tested from time to time, it was obvious that the proportion of dead spores was increasing gradually, as indicated by the loss of chlorophyll accompanied by the inability of the spores to swell. It seems probable that all spores which show chlorophyll on planting are viable if circumstances are favorable and sufficient time is allowed. The green spores swell until much larger than their original size, and appear viable for days and even weeks in the water cultures. Some give a belated germination but others gradually lose their chlorophyll and die, probably unable to adjust to unfavorable conditions. In one late culture of *O. Claytoniana,* comparatively few spores germinated in a week, although a considerable number contained chlorophyll. These spores, unfortunately, were tangled in a fungus which troubled this collection but not that of *O. regalis.* A little potassium permanganate solution added to the culture checked the fungus sufficiently to permit a fairly good germination. (The solution which is used to keep down fungi on peat cultures is a decidedly pink solution, made by dissolving a crystal or two of potassium permanganate in distilled water; a few drops of this was added to the water culture.)

After a year and a half of refrigeration, a few spores of both species germinated in four days, but about 25% in 14 days. Two years after collection, a few spores of each species germinated in four to six days, but as many as 15% had germinated in 10–12 days. At the end of three years, a few spores of *O. Claytoniana* germinated in four to five days, but later the germination reached

10%. About 5% of the spores of *O. regalis* had germinated in seven days and produced prothalli in the two- or three-celled stage, a stage which is common in two or three days with fresh spores; about 15% had germinated in 17 days.

The last test was made in January, 1951, when the spores had been under refrigeration for more than three and a half years. In the case of *O. Claytoniana,* only three spores had germinated in six days, but 25 spores had germinated in eight days, some prothalli having three cells and one even six; the total germination was scarcely 1% when fungi checked the culture. The spores of *O. regalis* began to germinate about the same time; more than 1% had germinated in eight days with one prothallus in the six-celled stage; germination continued slowly and in 13 days 4–5% of the spores had germinated.

In general, the spores of *O. regalis* did rather better than those of *O. Claytoniana,* probably not from any inherent superiority, but because they did not need to wrestle with the problem of molds. (The smooth paper used with *O. regalis* was probably more favorable for the preservation of the fern spores in an uncontaminated condition than the paper toweling.)

A collection of spores of *O. cinnamomea* L. made in May, 1948, has been held in refrigeration for more than two years and a half. These spores have given similar results in the retention of viability. It may also be of interest to mention that spores of *O. javanica* Bl. sent from Singapore by the kindness of Professor R. E. Holttum, gave about 50% germination after their eight-day airplane trip. Similar results were obtained with spores of *Todea barbara* (L.) Moore sent by airplane from Australia, by the kindness of Professor Ethel McLennan of the University of Melbourne.

If, originally, there had been any intention of an experiment with reference to the duration of viability of *Osmunda* spores, some attempt would have been made to determine the best conditions for the preservation of the spores, and also to maintain uniform conditions for testing the rate and percentage of germination. The summer tests were usually under more favorable conditions of light and temperature for germination and growth, than the winter tests. However, the results show that it is easy to keep viable spores of *Osmunda* spp., and they retain their viability for a surprisingly long time.

It might be added that this should be of interest to teachers who may wish to give a demonstration of swimming sperms. For this purpose there is probably nothing better than the *Osmunda* prothallus which may produce antheridia in six to eight weeks.[3] The antheridia are borne in great abundance over a period of many months, and each antheridium produces a large number of sperms which are usually very active. In many regions of the country the fruiting material can be collected in season, or if not available it can be sent from more favorable regions; the spores can be made available for culture at any time of the year by keeping them in a refrigerator. *O. regalis* has seemed to be slightly quicker in development, both in these cultures and on peat, than *O. Claytoniana* or *O. cinnamomea,* but all three species are good and produce vigorous long-lived prothalli.

MOUNT HOLYOKE COLLEGE,
SOUTH HADLEY, MASSACHUSETTS

[3] The culture of fern prothalli is not difficult if care is taken to avoid contamination by molds, as they flourish under the same conditions as fern prothalli. The spores can be sowed on sterilized peat, or on pieces of clay crock standing in water in a crystallizing dish covered with a glass plate or one part of a petri dish. The culture in water will not be long-lived unless a dilute nutrient solution is added later, but this is favorable for molds. North light is most favorable for the cultures, as direct sunlight is apt to lead to sun-scald.

The Climbing Fern in Vermont

HAROLD G. RUGG

Members of the Vermont Botanical Club have been looking for a station for *Lygodium palmatum* in Vermont for many years, especially as the late W. W. Eggleston, a very able botanist, listed this fern many years ago as one that might be found in the State. There is a small station for this fern in Winchester, New Hampshire, not far from the Vermont line in Brattleboro. It has also been found in Massachusetts not many miles south of the Massachusetts-Vermont line. Vermont botanists therefore have been hoping to find this fern in southern Vermont. It was somewhat of a surprise then when it was reported that Mr. W. C. Hosford, an able botanist and nationally known hybridizer of lilies, had found this fern in Morristown, a town in northern Vermont just north of Stowe and Mount Mansfield. Mr. Hosford very generously gave directions for finding the station. It is a very small one on the outskirts of an old sphagnum bog which has become almost dry and in which cattle roam at will. *Rhodora* and other shrubs were found there, many of which had been badly cropped by the animals. The station is not over six feet in diameter and is at an elevation possibly two feet above the old bog. The plants are growing in proximity to meadowsweet, hay-scented fern, New York fern and marsh fern. As cattle do not apparently like the hay-scented fern the plants of the climbing fern have escaped destruction. Herbarium specimens were collected and have been deposited in the Dartmouth College and Gray Herbarium, in the herbarium of the University of Vermont, and in the herbarium of the American Fern Society.

Other stations for the climbing fern ought certainly to be found in southern Vermont. Another fern which should be found in the southern part of the State, and for which there is now no known station, is the Massachusetts fern, *Dryopteris simulata.* This fern has been found in two or three places in southern New Hampshire.

DARTMOUTH COLLEGE.

The Holly Fern

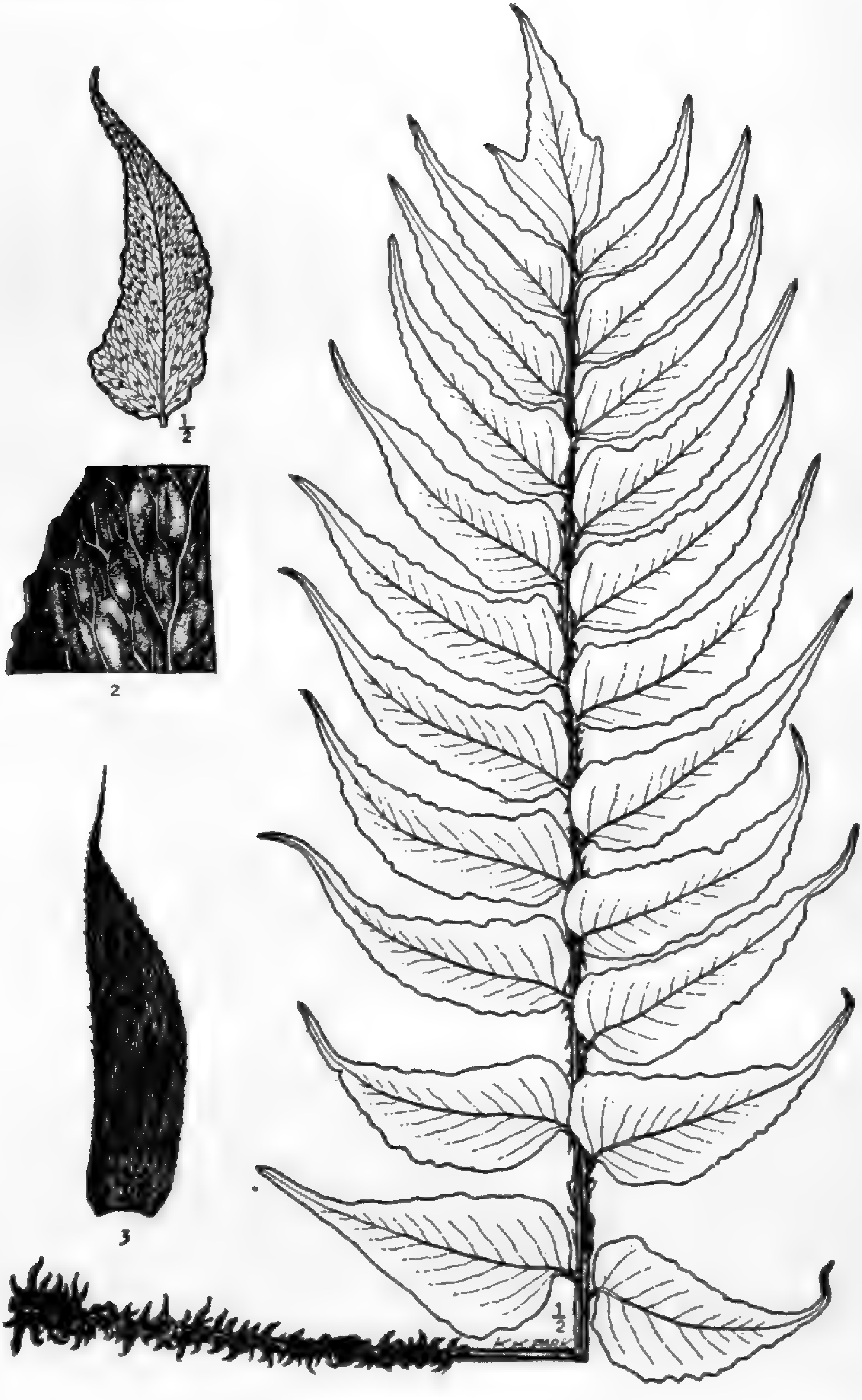
OTTO DEGENER AND ALEX D. HAWKES[1]

Among the more interesting genera of the pteridophyte family Aspidiaceae is *Cyrtomium* Presl, the few members of which are collectively called Holly Ferns. One species is a common plant in cultivation, with numerous horticultural variations frequently found in the trade, both in this country and abroad. It is widely utilized as a component of ornamental "fern dishes" and as a solitary and handsome pot-plant in its mature state.

Cyrtomium falcatum (L.f.) Presl, as this common Holly Fern is known, was originally described by the younger Linnaeus as *Polypodium falcatum,* from material collected in Japan. Its range has been augmented to include the adjacent areas of Korea, China, and Formosa; it also occurs as an adventive plant in the Hawaiian Islands, and as a presumed adventive in California and Florida. Its exact specific limitations are even today obscure, and it is suspected that hybrid forms exist between it and allied entities. The species has been placed in *Polystichum* by Diels, and recently in *Phanerophlebia* by Copeland.

The Holly Fern is a stiff erect plant with a stout, brown- or black-scaly rhizome about 5 cm. thick. This rootstock gives rise to a cluster of almost erect, rigid fronds 15 to 50 cm. long; they are furnished with longi-

[1] Taken, in part, from Otto Degener's forthcoming "Plants of the Tropics." The plate is copyrighted by Degener.



CYRTOMIUM FALCATUM

tudinally sulcate petioles, which are very shaggily covered with thin membranous, brown, linear- to broad-lanceolate, denticulate scales up to 2 cm. in length. The dark green blade varies from narrowly oblong to almost lanceolate in outline, measures from 10 to 20 cm. across its widest part, and is composed of from seven to fourteen pairs of alternate pinnae, which are never pinnatifid. These leaflets are very glossy on their upper surface, thickly coriaceous in texture, unequally ovate to falcate-ovate, acute to long-acuminate apically, and measure 5 to 10 cm. in length. Their margins are typically undulate or vaguely lobed, but the conspicuously thickened edges are otherwise entire; the basal portion is acuminate to cuneate, and the upper half of each pinna is customarily round-truncate. The pinnae are shortly stipitate, and the apical one is often more or less trilobate.

The sori of *Cyrtomium falcatum* are circular and abundantly scattered on the dorsal surface of the frond. The indusium is persistent, about 1 mm. across, initially whitish in color, but it soon turns brownish and eventually becomes blackish with somewhat paler margins. The veins are thick, particularly conspicuous on the dorsal surface, and anastomose on each side of the pinna midrib into numerous areoles containing the free veinlets; the sori are borne on connected or free veins in the areoles.

The junior author has seen this handsome fern growing as a common adventive on the old moldering walls of Fort Marion, St. Augustine, Florida, where it forms a showy display amidst a welter of mosses, liverworts, stray plants of *Asplenium,* and mats of *Polypodium polypodioides.* There its fronds are often somewhat etiolated, due to the absence of sufficient light in many of the situations in which it grows. The senior author found it completely naturalized on a rather bare, windswept precipice and in the wooded gullies overlooking Kalaupapa, Molokai, in 1928, and about Kawaihapai, Oahu, in 1950.

According to Copeland this genus (placed by him in *Phanerophlebia* Presl) is one of the numerous groups in close affinity with *Polystichum,* being probably closest in its alliance with *Lithostegia* Ching and *Cyclodium* Presl. Our present species is a handsome and interesting fern, with an unusual distributional pattern, not as yet fully understood. Copeland suspects this species to be native to California; the present authors consider it adventive there.

Waialua, Oahu, T. H. and Berkeley, California.

Notes on the Ferns of Kentucky, II. Trichomanes Boschianum

CLYDE F. REED

One of the rarest and perhaps most illusive ferns to find in Kentucky is the Filmy Fern. Its peculiar yet obligate habitat in well-darkened sandstone rockhouses offers a unique trip for the botanist or fern-lover.

In Kentucky, *Trichomanes Boschianum* is known from the rockhouses of the basal Pottsville sandstone of the Pennsylvanian formation. Back under these overhanging cliffs the Filmy Fern finds its habitat with such other species of plants as *Silene rotundifolia* and *Heuchera parvifolia* var. *Rugelii,* in one locality also with *Solidago albifrons,* all of which are only found in this formation in Kentucky.

The Filmy Fern was first recorded in Kentucky from Carter County being found by Dr. H. H. Hill of Cincinnati in 1872 and recorded in Williamson's Ferns of Kentucky in 1878. In 1873 and 1874, Prof. Hussey collected the fern in Carter County, and also in Edmonson and Barren Counties. Later, the Filmy Fern was found in Laurel and Rockcastle Counties. These were all the counties known to Williamson in 1878.

In 1938 McCoy, in his Ferns of Kentucky,[1] listed only three counties, Edmonson, Lawrence and Rockcastle. No specimens were cited in either of these publications. Again, MacFarland, in his Checklist of the Vascular Plants of Kentucky, mentions this fern as found in the state, but does not give any distribution.

To date the author has specimens or records from eleven counties in Kentucky. To the best of my knowledge all the localities are in the Pottsville sandstone formation, ranging from Carter County (probably the southern portion where the Pottsville crops out) through Morgan County and Lawrence County to Laurel and McCreary Counties, and then westward to Edmonson and Barren Counties.

The actual records and specimens of the Filmy Fern from Kentucky at hand are listed below.

BARREN Co.: Reported by Prof. Hussey, in Williamson's Ferns of Kentucky, as "found in more than twenty localities, always on rocks or moist earth, far under overhanging cliffs, at least where moisture never fails, and the direct rays of the sun do not reach during many minutes of the day. Usually the fronds are bedewed with moisture trickling from the rocks on which they grow." No records since.

CARTER Co.: Collected for the first time in 1872 in Kentucky in this county, but no definite locality cited by Williamson. Also found here the following two years by Prof. Hussey. Not found nor recorded since that time.

EDMONSON Co.: Specimens were given to a guide at Mammoth Cave, and were planted near the mouth of the

[1] This JOURNAL, 28: 41–46, 101–110. 1938.

SANDSTONE ROCKHOUSES ALONG RED RIVER, NEAR SKY BRIDGE AND NADA TUNNEL, WOLFE AND POWELL COUNTIES, KENTUCKY, THE HABITAT OF TRICHOMANES BOSCHIANUM cave in 1877. According to Williamson in 1878 they were doing fine. Mammoth Cave National Park, Oct. 16, 1934, *A. N. Leeds* (Herb. Phila. Acad.); June 22, 1935, *W. B. Youmans* (Herb. Phila. Acad.).

LAUREL CO.: Several localities in this county have been given for the Filmy Fern, as Rockcastle Springs and along the Rockcastle River.

LAWRENCE CO.: Specimens in the Herbarium of the Kentucky Agricultural Station, collected by Prof. A. R. Crandall, without date and definite locality.

MCCREARY CO.: Small patch in rockhouses near Yamacraw, collected by the author (*Reed* 18571), April 15, 1950.

MORGAN CO.: Abundant in rockhouses about half way between Wrigley and Blaze, collected March, 1950 by the author (*Reed* 18303).

POWELL CO.: Abundant in rockhouses at Nada Tunnel, associated with *Solidago albifrons, Silene rotundifolia* and *Heuchera parvifolia* var. *Rugelii,* collected October, 1949, by the author (*Reed* 17505).

ROCKCASTLE CO.: Recorded in McCoy's Ferns of Kentucky, probably based on notes in Williamson to the effect that it was found on the divide between the Rockcastle River and the South Fork of the Kentucky River. Rockcastle Springs, August 1876, Miss J. H. Rule (Herb. Phila. Acad.).

WHITLEY CO.: Reportedly observed by Dr. Frank MacFarland near the falls area of the Cumberland Falls State Park. Rockhouse along Trail no. 2, below Cumberland Falls, Cumberland Falls State Park, July 1, 1950, collected by Priscilla Reed (*Reed* 20308).

WOLFE CO.: In damp rockhouses under the Sky Bridge State Park, collected by the author, March 1948 (*Reed* 10913).

Shorter Note

DRYOPTERIS SETIGERA IN TEXAS.—Recently a miscellaneous lot of Texas fern specimens was received from Southern Methodist University among which was a specimen of *Dryopteris setigera* (Blume) Kuntze. This specimen was collected by Dr. Eula Whitehouse (No. 23089) in the long-leaf pine belt in State Forest No. 1, five miles east of highway 96, Kirbyville, Newton County, Texas, on March 26, 1950. This species, a native of the Old World tropics, is new to Texas.

The discovery of *Dryopteris setigera* in Texas is of particular interest since it was reported only recently from Conecuh County, Alabama, by Lloyd C. Crawford.[1] Previous to the above report, this species was thought to occur only in several counties of North Central Florida, i.e., Hernando, Highlands, Manatee, Orange, Osceola, Polk, Saint Johns, Seminole, and Volusia. It is usually found in swamps and wet woods.

With the finding of this introduced species in Texas the number of Pteridophytes now known to occur in that State is 103 species and 16 infraspecific forms and hybrids, including 4 naturalized or established Filicinae. The above summary of Pteridophyta in Texas is based on the writer's paper, "A Preliminary Survey of the Distribution of Texas Pteridophyta."[2]—D. S. CORRELL, *Division of Plant Exploration and Introduction, U. S. Department of Agriculture, Beltsville, Maryland.*

American Fern Society

The Society has always been proud of its reputation for friendliness amongst its members. However, of late years our membership has become so scattered that it is difficult to have more than a limited local acquaintance

[1] THIS JOURNAL 39: 124. 1949.

[2] Wrightia 1: 247–278. 1949.

with other members. It is especially difficult for new members to meet the older members and learn from them the fascination of ferns.

For the past several years members living in New Jersey have all been notified of a joint meeting with The Torrey Botanical Club. The meeting has been held in one of the local fern gardens giving members an opportunity to get acquainted. Guests are invited and the meetings have been well attended. The group now proposes to extend their activities to one or two field trips per year.

If you are interested in forming such a group in your state or locality our Treasurer, Mr. M. D. Mann, Jr., will supply an up-to-date list of names and addresses of any locality.

New Members

Mr. E. W. Cook, First Clark National Bank, Northfork, West Virginia

Prof. Frank J. Hilferty, Farmington State Teachers College, Farmington, Maine

Mrs. John E. Housel, R. D. 5, Somerville, New Jersey.

Dr. Gerald B. Ownbey, Department of Botany, University of Minnesota, Minneapolis 14, Minnesota

Sr. Hernando Sanchez M., Prado Sur 225, Mexico, D. F., Mexico

Mrs. Stanley D. Simon, 1030 Elm Park Drive, Cincinnati 16, Ohio

Mrs. Hope Sherman Smith, Pleasant Valley, Connecticut

Mr. Carl Starker, Jennings Lodge, Oregon

Miss M. Tindale, National Herbarium, Botanic Gardens, Syndey, Australia.

Changes of Address

Mr. William Bridge Cooke, 425 Loveland Avenue, Loveland, Ohio

Mr. A. M. Larwick, Route 1, Box 7638, Carmichael, California

Mr. Edward C. Stabler, Matthews 36, Cambridge 38, Massachusetts

Dr. Warren Herbert Wagner, Jr., Department of Botany, University of Michigan, Ann Arbor, Michigan

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ERRATA

Page 75, line 3. For **Solenopteris**, read **Solanopteris**.
Page 75, line 6. For *rhizomate*, read *rhizoma*.
Page 75, line 13. For *Solenopteris* **bifrons**, read *Solanopteris* **bifrons**.
Page 75, line 16. For *B. bifrons*, read *P. bifrons*.

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AMERICAN FERN SOCIETY, INC.

Membership List
Revised to December 31, 1951

Supplement to the American Fern Journal
Vol. 41, No. 4

(* Charter Member; + Life Member)

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Campbell, Dr. Douglas Houghton, Stanford University, Stanford, California 1915
Copeland, Dr. E. B., Department of Botany, University of California, Berkeley, California 1948
Looser, Dr. Gualterio, Casilla 5542, Santiago 6, Chile 1928
Waters, Dr. Campbell E., 5812 Chevy Chase Parkway, Washington, D. C. 1893

Ade, Ralph D., 2324 23rd Street A, Moline, Illinois 1946
Alger, Mrs. Philip L., 1758 Wendell Avenue, Schenectady 8, New York 1950
Allen, Dr. & Mrs. Edward P., 147 Alden Avenue, New Haven 15, Connecticut 1949
Allen, Dr. Fred H., 16 Fairfield Ave., Holyoke, Mass. 1921
Allen, Miss Mary N., 6 Academy Street, Worcester, Mass. 1941
Allen, Walter S., 144-19 35th Ave., Flushing, New York 1917
Allison, Dr. Benjamin R., Hewlett, L. I., New York 1950
Andrews, Henry N., Washington University, St. Louis, Mo. 1951
Artz, Miss Lena, Waterlick, Virginia 1948
Atkinson, Mrs. Lenette, 405 South Pleasant Street, Amherst, Massachusetts 1951
Bailey, Dr. Liberty Hyde, Sage Place, Ithaca, New York 1921
Baker, Miss Harriet E., 1927 Buckingham Road, Los Angeles 16, California 1941
Baker, William H., University of Idaho, Moscow, Idaho 1947
Ballard, F., Royal Botanic Gardens, Kew, Surrey, England 1944
Barkley, Dr. Fred A., 2343 West Iowa St., Chicago, Ill. 1941
Barnes, Mrs. Albert C., Latch's Lane, Merion, Pa. 1926
+Barnes, Mrs. William A., 2645 Edgewood Rd., Utica, N. Y. 1944
Barsalou, Mrs. H. L., 1241 Linda Vista Ave., Dayton, Ohio 1949
Bartlett, Prof. H. H., Dept. of Botany, University of Michigan, Ann Arbor, Michigan 1944
Bartsch, Dr. Paul, "Lebanon", Gunston Hall Road, Lorton, Virginia 1911
Bauer, J. William, "Botany Hill", Kimmswick 1, Missouri 1944
Beals, Alfred T., 274 Summit Avenue, Hackensack, N. J. 1949

Bean, Ralph C., 48 Emerson Street, Wakefield, Mass. 1920
Beard, Dr. John, 77 Durban Road, Pietermaritzburg, Natal, South Africa 1948
Beardslee, Mrs. John W., 25 Seminary Place, New Brunswick, New Jersey 1942
+Bechtol, L. A., c/o Almont Savings Bank, Almont, Mich. 1946
Beck, Mrs. Walter, Innisfree, Millbrook, New York 1928
Bedell, Dr. Sullivan, 1004 Lynch Bldg., Jacksonville, Fla. 1947
Behrends, Mrs. Dorothy, 1633 Golden Gate Avenue, Los Angeles 26, California 1951
Benedict, J. E., Jr., 945 Pennsylvania Avenue, N. W., Washington 4, D. C. 1923
Benedict, Dr. R. C., 1819 Dorchester Rd., Brooklyn, N.Y. 1905
Benson, Dr. Lyman, Pomona College, Claremont, Calif. 1945
Berko, S. J., P. O. Box 335, Braddock, Pennsylvania 1947
Bill, Miss Bertha, 12 Boynton Street, Worcester 2, Mass. 1944
Blake, Mrs. Anson S., Rincon Road near Arlington Avenue, Berkeley, California 1945
Blake, Dr. S. F., 2817 First Road N., Arlington, Va. 1945
Blomquist, Prof. H. L., Duke University, Durham, N. Car. 1934
Bloom, William W., 1002 Oak St., Valparaiso, Indiana 1948
Boatner, Dr. Florence G., 1334 Louisiana Avenue, New Orleans 15, Louisiana 1948
Boivin, Dr. Bernard, Division of Botany, Central Experiment Farm, Dept. of Agriculture, Ottawa, Canada 1950
Bonkston, Mrs. Aurelia E., 262, Montgomery, Louisiana 1950
Boyce, Mrs. David C., The Homestead, Evanston, Illinois 1930
Boyd, Howard J., 145 West 31st. St., Eugene, Oregon 1951
Boydston, Mrs. Kathryn E., Fernwood, Rt. 3, Niles, Mich. 1951
Bracelin, Mrs. H. P., c/o Dept. of Botany, University of California, Berkeley, California 1949
Bramm, Miss Florence, 117 N.Ewing St., Lancaster, Ohio 1947
Braun, Dr. E. Lucy, R.R. 13, Box 41C, Cincinnati 30, Ohio 1920
Brettle, Mrs. Marion B., 159 Pleasant Ave., Hamburg, N.Y. 1935
Brewer, Richard, 1506 Edith St., Murphysboro, Illinois 1950
Britton, Donald, 59 Teddington Park, Toronto 12, Canada 1946
Brooks, Karl L., 360 Madison Avenue, Albany 6, N. Y. 1951
Brooks, Maurice G., West Virginia University, Morgantown, West Virginia 1926
Broun, Maurice, Hawk Mountain Sanctuary, R. D. 2, Kempton, Pennsylvania 1934
Brown, Miss Babette I., Eastman Bldg., Prince Street, Campus, University of Rochester, Rochester 7, N. Y. 1948
Brown, Mrs. Haydn L., Main St., Atkinson, N. H. 1947
Brown, Hubert H., 9 Halford Ave., Toronto, Canada 1926
Burns, Newell J., 536 E. Dover St., Milwaukee 7, Wis. 1948
Burritt, Mrs. Bailey B., 16 Prospect Drive, Yonkers 5, New York 1949
Burton, Dr. Daniel F., State Teachers College, Mankato, Minnesota 1949
+Burton, Mrs. Verona Devine, State Teachers College, Mankato, Minnesota 1949
Buysse, Mrs. J. A., 121 Pershing Ave., Roselle Park, N.J. 1951

Cadbury, Dr. W. W., 274 W. Main St., Moorestown, N. J. 1951
Campbell, Dr. Douglas Houghton, Stanford University, Stanford, California 1915
Canan, Miss Elsie, 1023 Menoher Blvd., Johnstown, Pa. 1935
+Capp, Seth Bunker, Sub. P. O. Box 2041, c/o Middle City Station P. O., Philadelphia 3, Pennsylvania 1915
Carlson, T. O., 16 Hillcrest Road, Mountain Lakes, N. J. 1946
Carlson, Mrs. T. O., 16 Hillcrest Road, Mountain Lakes, New Jersey 1934
Carroll, Col. Robert P., Virginia Military Institute, Lexington, Virginia 1938
Cascio, Mrs. Peter J., 2600 Albany Avenue, West Hartford, Connecticut 1935
Cass, Charles L., 2229 Erie St., San Diego 10, Calif. 1951
Castellanos, Alberto, Canning 2904, Bajo C, Buenos Aires, Argentina 1949
Chamberlain, Glen D., 22 Academy St., Presque Isle, Me. 1939
Chandler, Albert, 221 W. Washington Ave., Kirkwood, Mo. 1941
Cheuvront, Elmer M., 514 Beaver Ave., West Aliquippa, Pa. 1948
Chillas, Richard B., Jr., 233 Winona Avenue, Philadelphia 44, Pennsylvania 1935
Chisholm, Mrs. Maud L., Proctor, Vermont 1923
Christopher, Dorothy E., 9920 Northern Boulevard, Cleveland 8, Ohio 1949
Chun, Dr. Woon-Young, Botanical Institute, Sun Yatsen University, 314 Ma Tou Wai Rd., Kowloon, Hongkong, China 1950
Clark, Mrs. B. Preston, 132 Marlboro St., Boston, Mass. 1928
Clarke, Miss Gladys, c/o G. W. Holliday, Milton, Wis. 1946
Clarke, Herbert M., Biology Building, University of Wisconsin, Madison 6, Wisconsin 1948
Clausen, Dr. Robert T., Dept. of Botany, Cornell University, Ithaca, New York 1934
Clevenger, Miss Sarah B., 717 South Henderson Street, Bloomington, Indiana 1949
Cobb, Boughton, 180 Madison Ave., New York 16, N. Y. 1946
Constantine, Thomas S., 72 Terrace, Katonah, N. Y. 1936
Cook, E. W., First Clark National Bank, Northfork, W.Va. 1951
Cook, John Hutchinson, 383 W. State St., Trenton, 8, N.J. 1948
Cooke, Wm. Bridge, 425 Loveland Ave., Loveland, Ohio 1939
Copeland, Dr. E. B., Dept. of Botany, University of California, Berkeley, California 1948
Correll, Dr. Donovan S., Mt. Pisgah Road, Avenel, Silver Spring, Maryland 1936
Crane, Mrs. Charles W., 174 Summit Ave., Summit, N. J. 1951
Crawford, Lloyd C., Route E, Evergreen, Alabama 1950
Croom, Neil, State University of New York, State Teachers College, New Paltz, New York 1951
Dansereau, Pierre, Dept. of Botany, University of Michigan, Ann Arbor, Michigan 1948
Darling, Cyrus, Box 193, Westborough, Massachusetts 1929
Davies, Mrs. Josephine B., 3621 N. E. Miami Street, Miami 37, Florida 1951
Davis, Wm. A., 3471 South Kansas Ave., Milwaukee 7, Wis. 1949

Deal, Mrs. Fern W., Cross Valley Road, Route 12,
Knoxville, Tennessee 1950
Deam, Charles C., Route 3, Bluffton, Indiana 1905
Deiro, Mrs. Paul, 4618 13th Ave. South, Seattle 8, Wash. 1951
Demaree, Delzie, Arkansas State College, Jonesboro, Ark. 1938
Demoise, Dr. Charles W., 17 O'Hara St., Greensburg, Pa. 1950
Derickson, Prof. S. H., Lebanon Valley College,
Annville, Pennsylvania 1935
Desmond, Hon. Thomas C., 94 Broadway, Newburgh, N. Y. 1943
DeVol, Dr. Charles E., 4208 So. Landess St., Marion, Ind. 1938
DeWolf, Gordon P., Jr., Dept. of Botany, Tulane University, New Orleans 18, Louisiana 1949
†Diddell, Mrs. W. D., 8092 Hawthorne St., Jacksonville, 6, Florida 1935
Dix, W. L., 801 Crown Street, Morrisville, Pennsylvania 1933
Dole, W. Herbert, 23 Overlook Ave., West Orange, N. J. 1926
Doray, Robert A., 560 White St., Springfield, Mass. 1941
Doubleday, Mrs. Arthur W., Woodstock, Vermont 1928
Douglas, Miss Gertrude E., 32 Clinton Rd., Melrose, Mass. 1951
Dowling, C. F., Jr., Grenada Company, Puerto Librador, Dominican Republic 1950
Dressel, Mrs. Emma R., Star Route, Livingston Manor, N.Y. 1945
Dunbar, Henry, F., Box 194, R.F.D. 3, Kingston, N. Y. 1938
Duncan, Wilbur H., Dept. of Botany, University of Georgia, Athens, Georgia 1949
Dunham, Mrs. F. G., 450 Beverly Road, Ridgewood, N. J. 1941
Dunlop, Prof. Douglas W., University of Wisconsin, 623 West State Street, Milwaukee 3, Wisconsin 1941
Earle, R. S., 101a Charles Street, Boston 14, Mass. 1927
Earle, Dr. T. T., Dinwiddie Hall, Tulane University, New Orleans 15, Louisiana 1938
East, Miss Laura A., Plymouth, Connecticut 1944
Eastwood, Sidney K., 5110 Friendship Avenue, Pittsburgh 24, Pennsylvania 1946
Edwards, James L., 27 Stanford Place, Montclair, N. J. 1932
Elliot, E. A., South Stoke Vicarage, near Reading, Berkshire, England 1939
Ellis, Erl H., P. O. Box 115, Idaho Springs, Colo. 1951
Emerick, A. E., 400 Bruce Street, Eaton, Ohio 1951
Emmons, Edwin T., 177 Lewis Street, Geneva, N. Y. 1915
English, B. E., 2265 Loma Vista St., Pasadena 7, Calif. 1949
Engstron, Harold, 680 Lenox Road, Glen Ellyn, Illinois 1951
Evans, Miss Lucille, 2129 E. Kenwood Boulevard, Milwaukee 11, Wisconsin 1936
Ewan, Joseph, Dept. of Botany, Tulane University, New Orleans 18, Louisiana 1930
Ewing, Mrs. Gifford C., 1205 Muirlands Drive, La Jolla, California 1948
Eyerdam, Walter J., 7531 19th Avenue, N. E., Seattle 5, Washington 1949
Fagley, Dr. Frederick, 60 Grammercy Park, New York, N.Y. 1932
Faust, Dr. Mildred E., Syracuse University, Syracuse 10, New York 1948

Feigley, Miss Margaret D., 544 Chestnut Street, Winnetka, Illinois 1949
Ferril, Mrs. W. C., 2123 Downing Street, Denver, Colo. 1941
Fessenden, G. R., 5820 Edgepark Road, Baltimore 14, Md. 1937
Fisher, George L., 611 West Pierce Ave., Houston 6, Tex. 1945
Fliflet, Thorleif, 128 Kenilworth Rd., Mountain Lakes, N.J. 1947
Flo, Mrs. Spencer C., 19 James St., Greenfield, Mass. 1948
Flowers, Seville, University of Utah, Salt Lake City, Utah 1938
Foote, Mrs. E. M., Cornwall Bridge, Connecticut 1925
Ford, W. T., 610 South 12th St., Fort Pierce, Florida 1951
Fosberg, Dr. F. R., Holmes Run Road, R. F. D. 1, Falls Church, Virginia 1946
Foster, Austin T., 25 East 86th Street, Apartment 10D, New York 28, New York 1951
Foster, Joe, 1 West Way, Orinda, California 1950
Foster, Lincoln, Falls Village, Connecticut 1950
Fraser, Donald A., Forest Insect Laboratory, Sault Ste. Marie, Ontario, Canada 1949
Frehse, Mrs. Robert M., 506 West Maplehurst, Ferndale 20, Michigan 1949
Frick, Dr. T. A., Dept. of Biology, Lincoln Memorial University, Harrogate, Tennessee 1945
Gannett, L. S., 120 East 16th St., New York, N. Y. 1928
Gaston, Mrs. John Zell, Webster, Texas 1947
Gebert, James L., Box 424, New Iberia, Louisiana 1947
Giauque, M. L. Ashley, 2643 Benvenue Avenue, Berkeley 4, California 1942
Gilbert, Neal W., 7809 Morningside Drive, N. W., Washington, D. C. 1940
Gillson, Mrs. Joseph L., Mullin Lane, Wilmington, Del. 1951
Gilmore, Howard, 97 Holland Road, Brookline, Mass. 1941
Glasgow, Mrs. Robert D., 1013 Washington Avenue, Albany 3, New York 1951
Goodman, George J., Dept. of Plant Sciences, University of Oklahoma, Norman, Oklahoma 1949
Goodrich, Calvin, Hawk Creek Rd., Rt. 2, Asheville, N. C. 1951
Grace, Mrs. Charles, Hilton Road, Slingerlands, N. Y. 1951
Grajek, A. C., 2928 South 15th St., Milwaukee, Wis. 1949
Grannis, Mrs. J. K., Flemingsburg, Kentucky 1940
Graves, Dr. Arthur H., 255 S. Main St., Wallingford, Conn. 1935
Graves, Miss E. Irene, 237 Summer St., Bridgewater, Mass. 1943
+Greene, F. C., Biltmore Arms Apt., 900 East 9th Street, Kansas City, Missouri 1915
Greshan, Mrs. W. B., 2862 Ionic Ave., Jacksonville, Fla. 1950
Grether, David F., Dept. of Botany, University of Wisconsin, Madison, Wisconsin 1950
Griesel, Wesley O., 1000 Cheuron Court, Pasadena 2, Calif. 1941
Groff, Miss Mary E., Charles Road, R.D.6, Lancaster, Pa. 1933
Grose, E. R., Sago, West Virginia 1950
Gunnison, Mrs. R. M., Quaker Acres, Pawling, New York 1941
Haas, Dr. Flora A., Box 623, Sorrento, Florida 1917
Hagenah, Dale J., 1961 W. Bethune St., Detroit 6, Mich. 1948
Hague, Stella M., 607 S. Van Buren St., Auburn, Ind. 1949

Halbeisen, Robert, 1141 Calvert St., Detroit 2, Mich. 1951
Hale, Mrs. Annie T., Hopkinton Road, Concord, N. H. 1943
Hallenbeck, Ealy, 14 Washington Road, Scotia, N. Y. 1938
Hamilton, George E., 2871 Dellwood Ave., Jacksonville, Florida 1950
Hardy, Miss Ruth W., Red Cedar Wild Flower Nursery, South Canaan Road, Rt. 7, Falls Village, Conn. 1949
Harlow, Richard C., 152 W. Main St., Westminster, Md. 1940
Harvill, Prof. A. M., Jr., Dept. of Biology, University of Alabama, P. O. Box 2047, University, Alabama 1949
Harwood, Dr. Jessie C., 337 West Walnut St,Ashland,Ohio 1948
Hauber, Mrs. M. N., R. D. 1, Lindley, New York 1948
Hayes, Mrs. Edwin A., 466 Elm St., New Haven, Conn. 1934
Higman, Harry W., 1320 E. 63rd. St., Seattle, Wash. 1932
Hilferty, Prof. Frank J., Farmington State Teachers College, Farmington, Maine 1951
+Hires, Miss Clara S., 152 Glen Ave., Millburn, N. J. 1941
Holdridge, Dr. L. R., Inter-American Institute of Agricultural Sciences, Turrialba, Costa Rica 1949
Holliger, Herbert H., Huron, Ohio 1949
Holmes, Dr. Francis O., Rockefeller Institute for Medical Research, 66th St. & York Ave., New York, N. Y. 1949
Hood, Mrs. Vance, R. D. 2, Boonton, New Jersey 1951
Housel, Mrs. John E., R. D. 5, Somerville, New Jersey 1951
Howard, Miss Freda C., 7 St. Clair St., Ticonderoga,N.Y. 1947
Humfeld, Philip H., 311 West 11th St., Hutchinson, Kans. 1949
+Hunnewell, Francis Welles, Washington Street, Wellesley, 81, Massachusetts 1915
Hutchinson, Mrs. Susan W., 720 Cumberland Road, Glendale 2, California 1923
Imshaug, Henry A., Dept. of Botany, University of Michigan, Ann Arbor, Michigan 1940
Irving, F. N., 3169 18th St.,N.W., Washington 10, D. C. 1940
Jehlen, C. F., R. F. D. 2, Millbrook, New York 1936
Jennings, Dr. Otto Emery, Carnegie Museum, Pittsburgh, Pennsylvania 1911
Johnson, Mrs. W. Keating, Ridge Pike above City Line, Roxborough, Philadelphia 28, Pennsylvania 1948
Johnston, William S., 65 Morris Lane, Scarsdale, N. Y. 1950
Jones, Prof. G. N., University of Illinois, Urbana, Ill. 1945
Jurica, Hilary S., St. Procopius College, Lisle, Ill. 1919
Kaeiser, Dr. Margaret, Southern Illinois University, Carbondale, Illinois 1949
Kaye, Fred W., 1961 W. Verdugo Blvd., Montrose, Calif. 1941
Kiener, Dr. Walter, Game, Forestation and Parks Commission, State Fair Grounds, Lincoln 3, Nebraska 1949
Killip, E. P., Smithsonian Institution, Washington, D.C. 1916
+Kittredge, Miss Elsie M., Maple St., Bristol, Vermont 1922
Knable, John P.,II, 615 Amberson Ave.,Pittsburgh, Pa. 1941
Knobloch, Dr. Irving W., Dept. of Biological Sciences, Michigan State College, East Lansing, Michigan 1935
Knotek, Joseph C., 2021 Superior St., Racine, Wis. 1947
Knowlton, Clarence H., 24 Elm Street, Hingham, Mass. 1911

Knox, Mrs. Wm. C., 649 Isle of Palms, Ft. Lauderdale, Florida 1951
Koeniger, Mrs. Florence, 55 Florence Avenue, San Anselmo, California 1945
Koster, Hollis, c/o Mrs. Wm. H. Wilson, Magnolia, N. J. 1940
Kozloff, Prof. Eugene N., Dept. of Biology, Lewis and Clark College, Portland 1, Oregon 1948
Kunneke, J. W., 2307 Village Drive, Louisville, Kentucky 1948
Larwick, A. M., Route 1, Box 7638, Carmichael, Calif. 1951
Lawton, Dr. Elva, Hunter College, 695 Park Avenue, New York, New York 1926
Lee, E. V., 3542A Market St., San Francisco 14, Calif. 1949
Legg, W. C., Mount Lookout, West Virginia 1941
Leonard, E. C., Smithsonian Institution, Washington, D.C. 1920
Lewis, Clarence, 1000 Park Avenue, New York, New York 1935
Lewis, Maynard B., 1314 Hoover St., Menlo Park, Calif. 1948
Liggett, W. E., 700 Swarthmore Lane, University City, Mo. 1940
Lippincott, Dr. Rebecca C., 122 West Main Street, Moorestown, New Jersey 1951
Litch, C. M., 7 Pearl Street, Fitchburg, Massachusetts 1916
Litchfield, Mrs. Norman, Barry Road, Quaker Farms, R. D. 2, Southbury, Connecticut 1949
Little, Elbert, L., Jr., 924 20th St. S., Arlington, Va. 1946
Lockard, Vene T., 15 South 10th St., Gladstone, Mich. 1948
Locke, John F., Box 1568, State College, Miss. 1949
Loeffler, Robert J., 83 New Bond St., Worcester, Mass. 1947
+Logue, Dr. Everett G., First National Bank Building, Williamsport, Pennsylvania 1920
Long, Bayard, 250 Ashbourne Road, Elkins Park, Philadelphia, 17, Pennsylvania 1911
Lommasson, Robert C., 2640 So. 13th St., Lincoln 2, Nebr. 1949
Looser, Gualterio, Casilla 5542, Santiago 6, Chile 1928
Lord, Mrs. Marie L., 101 Clay St., Burlington, Iowa 1940
Loughbridge, Gasper, Dept. of Biology, Davis and Elkins College, Elkins, West Virginia 1949
+Lowe, Mrs. Frank E., Box 65, Harrison, Maine 1917
Lownes, Albert E., P. O. Box 1551, Providence, R. I. 1924
Luhr, Mrs. Arthur, 555 Kellogg Ave., Palo Alto, Calif. 1941
Lukens, William W., Jr., Upper Gulph Road, Radnor, Pa. 1949
Lyon, Harold L., Exp. Sta. H. S. P. A., Honolulu 4, T.H. 1911
Lyonnet, Prof. Pierre, Colegio Cristóbal Colón, Sadi Carnot 38, Mexico D. F., Mexico 1948
McAvoy, Miss Blanche, 108 W. Ash St., Normal, Illinois 1920
McCauley, Dr. Robert H., Jr., Pacific Northwest Drainage Basin Building 24, Swan Island, Portland, Oregon 1941
McCleary, James A., Dept. of Botany, Arizona State College, Tempe, Arizona 1948
McCoy, Thomas N., Todd County High School, Elkton, Ky. 1934
McDaniel, Mrs. Jesse B., 2832 Ashley St., Houston, Tex. 1950
McDowell, Gladstone W., c/o Federal Power Commission, 417 Grant Building, Atlanta 3, Georgia 1947
McEachran, Hugh N. A., R. R. 1, Dunany Lachute, Co. Argenteuil, Quebec, Canada 1948

McGilliard, Miss Eleanor, Dept. of Biology, University of Chattanooga, Chattanooga, Tennessee 1935
McGregor, Dr. Ronald L., Dept. of Botany, University of Kansas, Lawrence, Kansas 1946
McIlvane, Dr. Harold, Box 155, University Station, Moscow, Idaho 1949
McKay, Donald, Orange Lake, Florida 1950
Mann, M. D., Jr., 625 Locust St., Roselle, New Jersey 1940
Mansfield, Dr. William, 371 Kenwood Ave., Delmar, N. Y. 1922
†Marble, John E., 1313 Garfield Ave., So.Pasadena, Calif. 1928
Mark, Miss Clara G.,270 So. State St., Westerville, Ohio 1913
Marsh, Mrs. Spencer S., Midwood Terrace, Madison, N. J. 1927
Masek, John, Apopka, Florida 1935
Massey, Prof. A. B., Virginia Polytechnic Institute, Blacksburg, Virginia 1935
Mathews, Mrs. W. R., 2120 Amelia St., Shreveport, La. 1946
Matthews, Miss Velma D., Coker College, Hartsville, S.C. 1940
Mauro, S., 2643 N. W. 22nd Court, Miami, Florida 1944
Milne, Dr. D. M., Bank Commerce Bldg., Portland 3, Maine 1947
Moore, Prof. Dwight M., Dept. of Botany, University of Arkansas, Fayetteville, Arkansas 1935
Moore, Dr. George T., Missouri Botanical Garden, St. Louis 10. Missouri 1915
Moore, Miss Jewel, Dept. of Biology, Arkansas State Teachers College, Normal Station, Conway, Arkansas 1947
†Moore, Dr. John W., Dept. of Botany, University of Minnesota, Minneapolis 14, Minnesota 1946
Morgan, Rev. A. Rufus, Box 319, Franklin, N. C. 1949
Morgan, Mrs. Weld, 54 West St., Worcester, Mass. 1943
Morton, C. V., Smithsonian Institution, Washington, D. C. 1940
Moss, Mrs. C. E., Box 1176, Johannesburg, South Africa 1916
Moul, Edwin T., Botany Dept., Rutgers University, New Brunswick, New Jersey 1945
Muenscher, W. C., Dept. of Botany, Cornell University, Ithaca, New York 1949
Murray, Miss Mary Aileen, De Paul University, Chicago 14, Illinois 1949
Mutchler, Miss Marjorie, 71 West 8th St., Bayonne, N. J. 1942
Myers, Dr. R. M., Western Ill.State College,Macomb, Ill. 1947
Neeman, James, Twin Trees, Garberville, California 1947
Neidorf, Charles, 127 Cannon Street, New York, New York 1937
Newell, Chauncey Jackson, Alstead, New Hampshire 1902
Norton, Leroy F., Box 123, Presque Isle, Maine 1941
*Noyes, Miss Elmira E., 931 Baldwin Ave., Norfolk 7, Va. 1893
Nunan, Mrs. T. J., 1105 8th St., Eureka, California 1949
Oechler, Mr. & Mrs. Dale G., c/o J. F. Anderson, Short Hills, New Jersey 1946
Ogden, Mrs. E. C., 20 Myrtle Street, Orono, Maine 1937
Oldham, W. L., 1111 South Weaver St., Springfield, Mo. 1946
Osgood, Miss M. Elsie, State Normal School, Lyndon Center, Vermont 1940
Osmun, Prof. A. Vincent, Shade Tree Laboratories, University of Massachusetts, Amherst, Massachusetts 1901

Osterlund, P., 131-15 140th St., South Ozone Park,
New York, New York 1920
Otis, Dr. Mabel H., 815 Fifth Avenue Bldg., Moline, Ill. 1933
Ownbey, Dr. Gerald B., Dept. of Botany, University of
Minnesota, Minneapolis 14, Minnesota 1951
Palmer, Ernest J., 321 South Main St., Webb City, Mo. 1909
Palmer, Dr. T. H., 1939 Biltmore St. N.W., Washington, D.C. 1911
Patnode, John S., 24 Clinton Avenue, Pittsfield, Mass. 1945
Peters, George H., 175 E. Seaman Ave., Freeport, N. Y. 1940
Peterson, Mrs. E., 11305 N. E. 2nd Place, Miami 38, Fla. 1951
Phair, Miss Gertrude G., 804 E. 19th St., Brooklyn, N.Y. 1916
Phelps, Mrs. Orra Parker, Gansevoort, N. Y. 1949
Phillips, Walter S., Dept. of Botany, University of
Arizona, Tucson, Arizona 1945
Pichi-Sermolli, Dr. Rodolfo, Istituto Botanico, Universita di Firenze, 4 via Lamarmora, Firenze, Italy 1941
Placak, Dr. Joseph C., Jr., 2404 Overlook Road, Cleveland 6, Ohio 1949
+Polunin, Dr. Nicholas, Gray Herbarium, Harvard University, Cambridge 38, Massachusetts 1950
Ponce, Amelia Mesa de, Calle Juan Delgardo 455, Vibora,
Habana, Cuba 1950
Pond, Bremer W., 5 Boylston Street, Cambridge, Mass. 1910
Poole, Dr. James P., Dept. of Biology, Dartmouth College,
Hanover, New Hampshire 1940
Pretz, Harold W., 123 South 17th St., Allentown, Pa. 1909
Proctor, George R., Science Museum, The Institute of
Jamaica, Kingston, Jamaica 1938
+Rapp, William F., Jr., 1219 Ivy St., Crete, Nebraska 1943
Reed, Dr. Clyde F., Harford and Cub Hill Road, Towson, Md. 1950
Reid, Mrs. Alex D., 260 Boulevard, Mountain Lakes, N. J. 1948
Rembert, Mrs. R. M., Rockledge, Florida 1944
Richards, Mrs. Elizabeth, Walnut Cottage, South
Lyndeboro, New Hampshire 1939
Risley, Mrs. Thomas E., 1044 N. Van Ness Ave., Fresno, Cal. 1951
Robbins, Prof. G. Thomas, Dept. of Botany, University
of California, Berkeley 4, California 1949
Rogers, Mrs. Charles H., 20 Haslet Ave., Princeton, N.J. 1941
Rogers, Mrs. J. R., 3107 Union St., Eureka, California 1948
Rooney, Mrs. Anna K., 29 Oakland Ave., Warwick, Orange Co.,
New York 1916
Rugg, Harold G., Box 187, Dartmouth College, Hanover, N. H. 1906
+Rusk, Hester M., 26 Stoddard Place, Brooklyn 25, N. Y. 1934
+Rust, H. B., 1507 Ridge Road, Briminghan 9, Alabama 1944
Sadler, Miss Nettie M., 503 Allen St., Syracuse 10, N.Y. 1943
Sanchez M., Sr. Hernando, Prado Sur 225, Mexico, D.F., Mex. 1951
Sanchez, Sr. José, Colegio Ignacio Zaragoza, Hidalgo
sur 405, Saltillo, Coahuila, Mexico 1945
Sargent, F. H., 2425 N. Underwood St., Falls Church, Va. 1951
Scamman, Miss Edith, 474 Portland Road, Saco, Maine 1937
Scarborough, Henry H., Jr., Botanical Laboratories,
University of Texas, Austin 12, Texas 1951
+Schaeffer, Robert L., Jr., 30 N. 8th St., Allentown, Pa. 1949

Schields, Miss Wilma, 21 Chickatabot Road, Quincy, Mass. 1950
Schmeidhouser, Mrs. A., 173 East 24th St., Paterson, N.J. 1951
Schmidt, Miss Claudia, 39 Ely Avenue, West Springfield, Massachusetts 1937
Schmidt, Dagmar, Box 794, Watsonville, California 1947
Schreiter, Seymour L., 505 Comstock Ave., Syracuse, N.Y. 1950
Schulte, Miss Muriel B., 701 Clinton Avenue, Newark 8, New Jersey 1946
Schuurman, J. A., c/o High Commissioner of the Netherlands, Gumbir Timor N3, Djakarta, Indonesia 1934
Scott, Samuel, 140 So. Hamilton Ave., Greensburg, Pa. 1950
Scully, Dr. Francis J., 904 Medical Arts Building, Hot Springs, Arkansas 1934
Sedgwick, J. H., 4800 Prospect Road, Peoria 4, Illinois 1941
Segars, Charles B., Box 3, University, Alabama 1950
Sener, Ruth, 233 Charlotte Street, Lancaster, Penna. 1932
Seymour, George W., Keuka Park, Yates Co., New York 1941
Sharp, Prof. A. J., Dept. of Botany, University of Tennessee, Knoxville 16, Tennessee 1940
Sharpe, Dr. M. R., Uxbridge, Massachusetts 1929
Shaver, Dr. J. M., Peabody College for Teachers, Nashville 4, Tennessee 1934
Sherff, Earl E., 7419 Stewart Ave., Chicago 21, Illinois 1949
+Shields, Edward M., 100 South Darlington Street, West Chester, Pennsylvania 1940
Shuck, Dr. Arthur L., Dept. of Biology, Southwestern State College, Weatherford, Oklahoma 1950
Sidney, Cedric, 111 Rosewood Drive, Hammond, Louisiana 1941
Simon, Andrew, 7727 York Road, Towson 4, Maryland 1951
Simon, Mrs. Stanley D., 1030 Elm Park Drive, Cincinnati 16, Ohio 1951
Singeltary, Mary L., Kissimmee, Florida 1934
Skidmore, Mrs. Andrew T., Pleasant Valley, New York 1950
+Slater, William A., Hunt, Texas 1933
Smith, Dr. A. C., Smithsonian Institution, Washington 25, D. C. 1931
Smith, Dr. A. V., Dept. of Botany, Catholic University of America, Washington 17, D. C. 1939
Smith, Dr. Budd E., Dept. of Biology, Wake Forest College, Wake Forest, North Carolina 1949
Smith, Mrs. Frank C., Jr., 32 Cedar Street, Worcester 2, Massachusetts 1951
Smith, Mrs. Hope Sherman, Pleasant Valley, Connecticut 1951
Smith, Jesse F., 347 Main Street, Suffield, Conn. 1949
Smith, Miss Ora B., 821 Bergen Ave., Jersey City, N. J. 1939
Somerville, Mrs. Mary F., 978 Lincoln Way East, Chambersburg, Pennsylvania 1923
Stabler, Edward C., Matthews 36, Cambridge 38, Mass. 1950
Standley, Paul C., Escuela Agricola Panamericana, Apartado 93, Tegucigalpa, Honduras 1915
Steere, Dr. William C., Dept. of Biological Sciences, Stanford University, Stanford, California 1935
+Steil, William N., 1926 No. 53rd St., Milwaukee, Wis. 1916

Stetten, Dr. Dewitt, Whitebridge Farm, Rushland, Bucks County, Pennsylvania 1947
Stevens, Mrs. Leslie B., 95 Grove Street, Plantsville, Connecticut 1949
Steward, Orville M., P. O. Box 19, Fordham Branch, New York 58, New York 1951
Steyermark, Dr. Julian A., Chicago Natural History Museum, Chicago 5, Illinois 1948
Stifler, Mrs. James M., 315 16th St., Bradenton, Fla. 1935
St. John, Dr. Edward P., Floral City, Citrus Co., Fla. 1934
St. John, Robert P., R. D. 2, Newark, Delaware 1934
+Stockman, Charles C., II, 153 High Street, Newburyport, Massachusetts 1946
Stokes, Mrs. Francis J., The Mill, Darlington, Md. 1940
Stokey, Prof. Alma G., Dept. of Plant Sciences, Mt. Holyoke College, South Hadley, Massachusetts 1949
Stone, Miss Edna L., 3216 44th St., Washington 16, D. C. 1928
Stone, Orra L., 22 Pearl Street, Clinton, Massachusetts 1951
Storer, Robert W., Museum of Zoology, University of Michigan, Ann Arbor, Michigan 1944
Storey, Oliver W., 924 Golf Lane, Wheaton, Illinois 1934
Stoudt, Harry N., Dept. of Biology, Temple University, Philadelphia 22, Pennsylvania 1949
Strattan, Mrs. G. W., Inwood, Buck Hill Falls, Penna. 1916
Strowger, Berk, 2434 N. W. Kearney Street, Portland, Ore. 1947
Stubbs, Thomas M., 111 W. Hampton Ave., Sumter, S. Car. 1941
Sudsbury, Mrs. Eleanor, Murphy, Oregon 1949
Svenson, Dr. Henry K., American Museum of Natural History, New York 24, New York 1931
Tanger, Mrs. Charles Y, 318 North President Avenue, Lancaster, Pennsylvania 1930
Tanger, J. C., Jr., 518 Carlisle St., Hanover, Penna. 1941
Taylor, Dr. Aravilla M. 207 Main St., Delhi, New York 1923
Taylor, Prof. T. M. C., University of British Columbia, Vancouver, Canada 1932
Teresita, Sister M., Holy Family Convent, R. F. D. 1, Manitowoc, Wisconsin 1944
Terrell, Mrs. Edward E., c/o G. R. MacLean, Route 2, Madison, Wisconsin 1951
Thacher, Mrs. A. B., 486 Scotland Road, South Orange, New Jersey 1941
Thompson, J. D., Jr., 509 1/2 Polk Street, Amarillo, Texas 1950
Thompson, J. W., 5245 20th Ave. South, Seattle, Wash. 1928
Thurston, Edward D., Jr., Sharon, Connecticut 1937
Thurston, Mrs. Edward D., Jr., Sharon, Connecticut 1940
Tilley, Trenor P., 1356 Northampton Street, Holyoke, Massachusetts 1921
Tindale, Miss M, Botanic Gardens, Sydney, Australia 1951
Trudell, Harry W., 1309 Highland Ave., Abington, Pa. 1919
Truesdell, Horace W., Bluemont, Virginia 1948
Tryon, Mrs. Alice F., Missouri Botanical Garden, St. Louis 10, Missouri 1947

Tryon, Dr. Rolla M., Jr., Missouri Botanical Garden, 2315 Tower Grove Avenue, St. Louis 10, Missouri 1932
Turner, Mrs. H. M., 88 Barnett Street, New Haven, Connecticut 1930
Valentine, Mrs. Elizabeth A., 3943 Locust Street, Philadelphia 4, Pennsylvania 1946
Van De Water, Dr. C. M., 82 Essex Road, Summit, New Jersey 1947
Van De Water, Mrs. Elinore S., 82 Essex Road, Summit, New Jersey 1947
Vincent, Mrs. Myron H., 1512 12th Avenue, San Diego, California 1917
Voth, Dr. Paul D., Dept. of Botany, University of Chicago, Chicago 37, Illinois 1942
Wagner, Warren H., Jr., Dept. of Botany, University of Michigan, Ann Arbor, Michigan 1940
Walder, George W., 740 Belmont Avenue, Fresno, Calif. 1951
*Waters, Dr. Campbell E., 5812 Chevy Chase Parkway, Washington 15, D. C. 1893
Weatherby, Mrs. Charles A., 27 Raymond Street, Cambridge 40, Massachusetts 1914
West, Erdman, Florida Agricultural Experiment Station, University of Florida, Gainesville, Florida 1942
Wherry, Prof. Edgar T., University of Pennsylvania, Philadelphia, Pennsylvania 1918
Whitehead, John W., 424 West 69th Street, Los Angeles 3, California 1936
Whitehouse, Eula, Box 739, Southern Methodist University, Dallas 5, Texas 1949
†Whitney, Mrs. Elsie G., 104 Adams Place, Delmar, New York 1930
Wiehe, Paul O., Agricultural Research Station, Likuni, Lilongew, Nyasaland, Africa 1948
Wiggins, Dr. Ira L., Dudley Herbarium,Stanford University, Stanford, California 1932
Wiley, Miss Farida A., Museum of Natural History, New York 24, New York 1927
Wilkens, Hans, 424 South 15th Street, Reading, Pennsylvania 1927
Winne, William T., Box 367, R. D. 1, Schenectady, New York 1950
Witschen, Mrs. William J., 217 West 6th Avenue, Roselle, New Jersey 1951
Wright, Mrs. C. H. C., 9 Lowell Street, Cambridge, Massachusetts 1935
Wright, Miss Mary F., 231 Winona Street, Philadelphia 44, Pennsylvania 1925
Young, John P., Renwick Drive, Ithaca, New York 1920
Zelley, Miss Grace S., 960 Columbus Road, Burlington, New Jersey 1942
Ziegler, A. W., Dept. of Botany, Florida State University, Tallahassee, Florida 1950